

CORE JAVA

2015

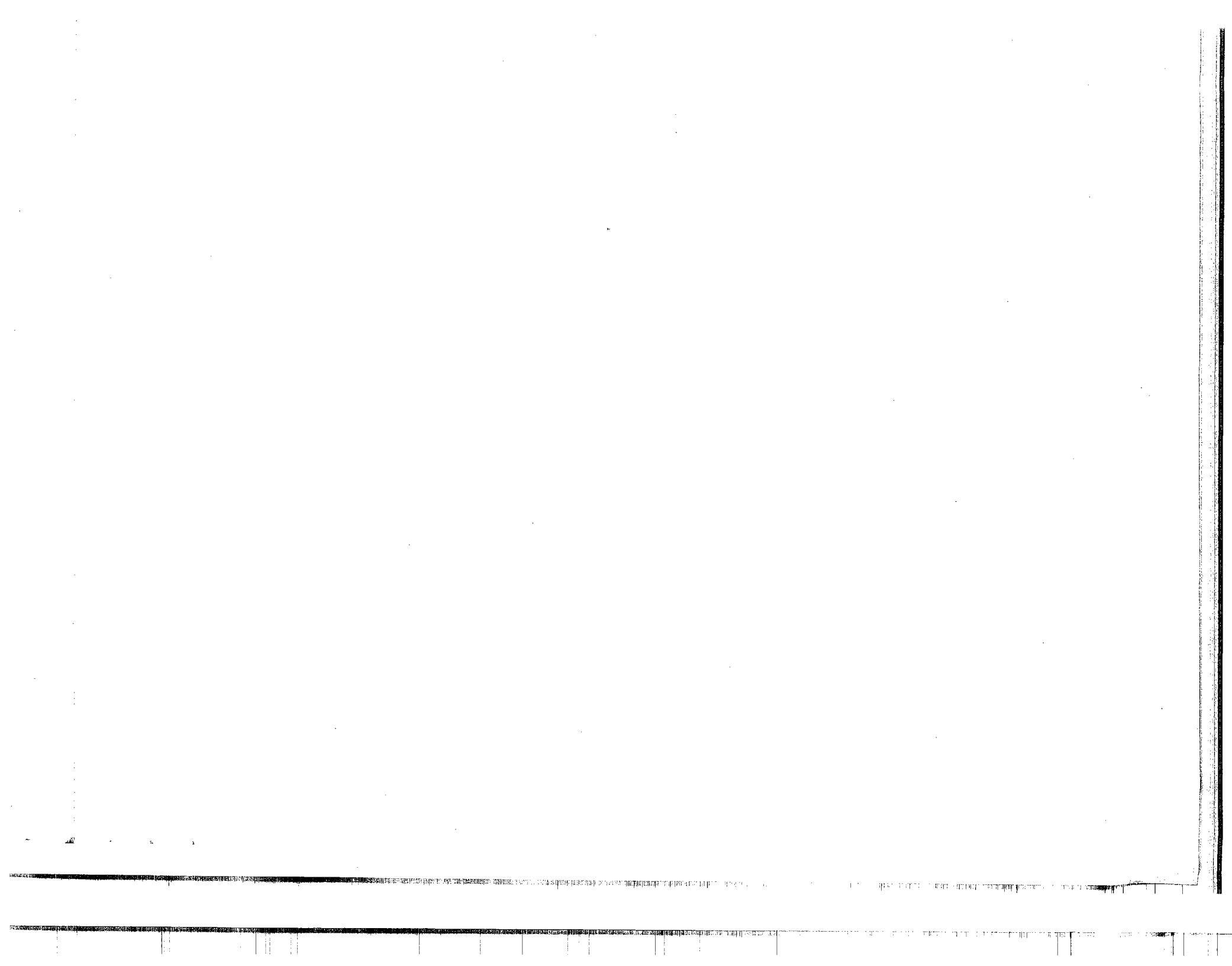
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→ Defn of S/w:

1

A s/w is a collection of programs meant for performing same operations.

In real world we have so many no. of operations which are performed by many no. of s/w's for the simplicity of upcoming programmers operations & s/w's classified into 3 types. They are

1. system s/w
2. Application s/w
3. Internet s/w

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System software:

In real world we've 3 projects which are comes under s/s s/w development.

1. Development of device drivers (s/w for printer, scanner, tablet, digital pad etc)
2. Development of language compilers, interpreters etc
3. Development of RTOS (Windows OS's, UNIX, LINUX, Solaris, MAC etc...)

In order to develop the above projects which are classified under s/s s/w we use the following languages.

→ C, 8086

→ The above languages are popular for development of s/s s/w projects becoz these languages contains many no. of features which are useful to interact with H/w devices.

Application SW :-

The purpose of appli sw is to develop the project appli to the organizations.

Some of the organizations are

- * Financial Sector (Banking, Insurance etc)
- * Health care sector (Hospitality, Diagnostic etc)
- * Transportation sector (Railway, Airlines etc)
- * Educational sector (Schools, Colleges etc) etc

Inorder to develop an appli sw for an organization we use the following technologies. They are

1. Front End Technologies
2. Back End Technologies

Front End Technologies:-

The purpose of front end technologies is that to develop GUI apps (look & feel apps).

In real world we've 2 types of front end techies. They are

(a) platform dependent front end technologies.

EX:- Developer 2000 (Oracle Corp)

visual Basic (Microsoft)

If we develop any GUI app with the above 2 techies then they runs on Microsoft provided OS's only but not able to run by default on nono these techies are called "PDFET"

b) Platform Independent front end technologies :- 3

EX- AWT
Applets
Swings } Java Concept,
SUN microSIS AWT- Abstract window toolkit .

If we develop any GUI application with the above concepts then such GUI apps run on each & every OS.

Hence, these techs are called "PIDEFT".

2. Back End Technologies :-

The purpose of back end techs is that to achieve data persistency (Storing the data permanently).

We can achieve the data persistency in 2 ways in world. They are

a, By using files

b, By using data base s/w's

If we store the data permanently in the form of files then any unauthorized user can modify the data of the file becoz file concept of any language doesn't contain any security in the form of user name & password. Hence, files are unsecured & industry not recommended to use.

If we store the data permanently in the form of data base s/w's then unauthorized users can't modify the data of data base becoz most of the data base s/w products provides high security in the form of

4 The following table gives database & its vendor name.

DB Slw Name	DB Slw Vendor Name
Oracle	oracle Corp
SQL server	MICROSOFT
DB2	IBM
1	1
1	1
1	1

Q17 :- Define stand alone appil & distributed appil?

Ans :- A stand alone appil runs in the context of local disc & whose results can be accessible in the same machine but not accessible across the universe.

Ex - All the projects of DB Slw & APPIL Slw.

Distributed Appils runs in the context of browser/ www & whose results are sharable across the universe.

Ex - Web sites (Yahoo, Gmail etc)

2- ATM based appils

3- Credit card based appils

4- Net banking appils

5- e-commerce related appils

Internet Slw :-

5

The purpose of Internet Slw is to develop distributed apps.

To develop distributed apps we use the following languages/technologies.

→ Java developed at SUN Micro System INC, USA (Handed over by Oracle Corp)

→ .Net developed at Microsoft INC, USA

Hence, Java is one of the internet Slw developed at SUN Micro System, released to the real world, used by all the programmers for developing each & every app in & Java is more popular for developing distributed apps.

History of Java :-

→ Java is one of the programming language or technology treated by the programmers as "Internet Slw".

& it is used for developing each & every app in & it is more popular for developing distributed app.

→ The Java Slw developed at SUN Micro System INC, USA

(Handed over by Oracle Corp) & developed under the guidance of James Gosling (Father/creator of Java).

→ The Java Slw started its development in the early of the year 1990 & released to the real industry in the middle of the year 1995 on the name of "OAK".

6 which is the original name of Java & scientifically it is tree name & it has taken 18 months to develop.

→ In those days the OAK SW was popular for developing device level SW's only (Electronic, mechanical & automobile devices) but not popular for developing apps related to Internet SW & appin SW. This is the industry experts opinion. (1991)

→ To fulfil all the requirements of the industry SUN micro system developers has perform them re-engineering operation on OAK SW & released to the real world on the name of Java in the year 1995. Scientifically Java is the one of the coffee seed name. At present the Java SW is available in 3 categories. They are

a, J2SE (Java 2 Standard Edition)

b, J2EE (Java 2 Enterprise Edition)

c, J2ME (Java Micro/mobile Edition)

→ In the industry J2SE is used for developing client side apps, J2EE is used for developing server side apps & J2ME is used for developing wireless apps.

+
Version in Java:-

The following table gives Java technology version & Java language version.

Java technology version	Java language version
JAVA	JDK 1.0 JDK 1.1
JAVA 1	JDK 1.2 JDK 1.3 JDK 1.4
JAVA 5	JDK 1.5 (Tiger) 5.0
JAVA 6	JDK 1.6
JAVA 7	JDK 1.7
JAVA 8	JDK 1.8

In the present industry we are using JDK 1.5 (5)

1.6.
Download JDK 1.5 (1.6) 1.7 1.8 ^{free} from www.sun.com (5)

www.oracle.com
NOTE:- In the present industry J2SE must be called as JSE (5) Java SE, J2EE must be called as JEE (5) Java EE and J2ME must be called as JME (5) Java ME.

8 Features / Buzzwords of Java :-

Features are nothing but the services/facilities/functions/functionalities provided by language developers in the language which are used by programmers for developing real time apps.

Java programming contains 13 features. They are

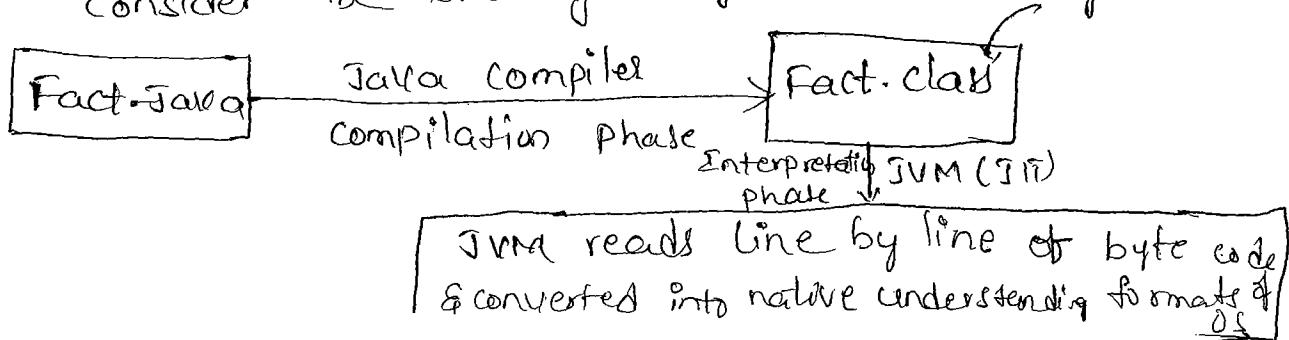
1. Simple
2. Platform Independent
3. Architectural Neutral
4. Portable
5. Multi-threaded
6. Networked
7. Distributed
8. High Performance
9. Highly Interpreted
10. Dynamic
11. Robust (Strong)
12. Secured
13. OOPL

Simple :-

Java is one of the simple programming language because of the following 4 important technical factors.

a) Java Programming eliminates a complex concept called pointers. So, that app development time is less & app execution time is less because of magic of byte code.

Consider the following diagram.



Defn of Byte code :-

- Byte code is the set of optimized instructions generated by Java compiler during compilation phase & the nature of byte code is much powerful than pointer code of C, C++ languages.

Defn of JVM:- (Java Virtual Machine)

JVM is one of the program developed SUN Micro SLS developers, available as a part of Java SW & whose role is reading the line by line of byte code & converted into native understanding format of OS.

Hence, byte code is OS independent & JVM is OS dependent.

Defn of JIT:- (Java Just in time compiler)

JIT is one of the program developed by SUN Micro SLS developers, available as a part of JVM & whose role is reading the ^{entire} line by line of byte code at once & converting into understanding format of OS.

In otherwords, the role of JIT is to speed up the interpretation phase.

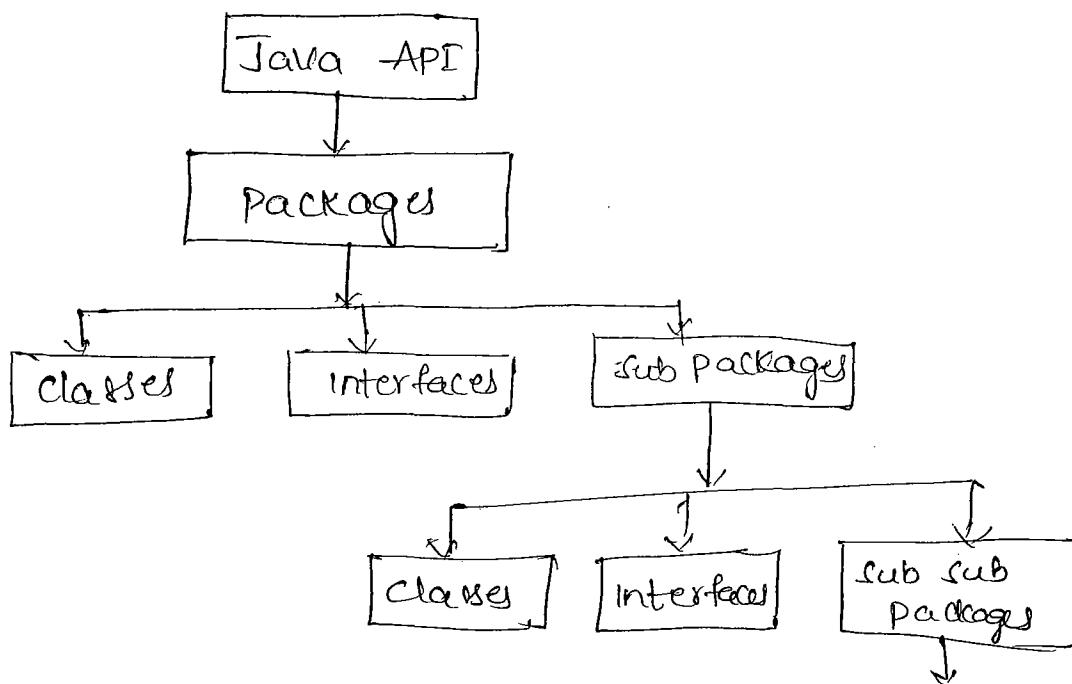
Hence, in this context Java is one of the compilation & interpretation based programming language.

10

b. Java programming provides rich set of API (Application Programming Interface).

Def of API :-

An API is a collection of pre-defined packages. A package is a collection of classes, interfaces & sub packages. A sub package internally contains collection of classes, interfaces & sub sub packages etc.



c. Java programming language provides in build facility called "garbage collector" which will collect un used memory space for improving the performance of Java based application.

Def of garbage collector :- (GC)

A GC is one of the 8 background Java programs which running along with our regular Java program for improving the performance of Java.

- Java Programming provided user friendly syntaxes which makes us to develop error free programs quickly.

Platform Independent

A language or technology is said to be platform independent if & only if whose applications runs on each & every OS.

In order to say a particular language is platform independent, it has to satisfy the following properties.

1. The language/technology related data types must take same amount of memory space on all OS's.
2. The language/technology must contain some special programs & whose role is converting native understanding format of one OS into native format of another OS.

The languages like C, C++ etc & whose apps are treated as platform dependent becoz these languages never satisfied the above ① & ② properties.

The language like Java & whose related apps are treated as platform independent becoz Java satisfies the above ① & ② properties.

Multithreading :-

The aim of multithreading concept is to provide concurrent access/exection.

A flow of control is known as thread.

The purpose of thread is to execute logic of the java program which is written in the form of user defined methods.

If a java program is containing multiple flow of controls then it is known as multithreaded.

The languages like c/c++/pascal,cobol etc are treated as single threaded modelling languages becoz their execution whose appii takes more environment provides single flow of control.

They provide sequential execution whose appii takes more execution time & does not contain any library for development of multithreading based appii.

The languages/technologies like java & .Net are treated as multithreaded modelling languages becoz their execution environment provides multiple flow of control provides concurrent execution, whose appii takes less execution time & provides an effective library for development of thread based appii.

When we write a java program there exists 2 types of threads.

a. Foreground/child thread :-

A foreground thread is one which is always executing logic of a java program which is written in the form of user defined methods.

b. Background/parent thread :-

A background thread is one which is monitor execution

Q 13)

The real time implementation of multithreading concept is that to develop real world server softwares such as Tomcat, weblogic (BEA systems, websphere etc). In otherwords most of the real world server softwares developed by third party server vendors in Java language by using multithreading concepts.

Hence multithreading of Java is one of the specialized form of multitasking of operating system.

Q:- How do you justify "Each & every Java program is multithreaded".

When we execute any Java program, the logic of the Java program, the logic of the Java program is executed by one of the thread known as foreground thread. To monitor the execution started of foreground thread, one more thread is created known as a background thread. So, Java Program is containing 2 threads hence every Java program is multithreaded.

High Performance :-

Java is one of the high performance language becoz of following factors.

1. Magic of byte code (use less execution time)
2. Automatic memory management becoz of garbage collector (collect unused memory space for improving performance of Java app)

Highly Interpreted :-

In the initial versions of Java compilation phase is very faster & interpretation phase is ~~also~~ slow which is one of the industry compliments & complaints.

In the later versions of Java SUN developers has developed a program called JIT (Just in time compiler) & added as part of JVM whose role is to speed up interpretation phase by

⑭ reading the entire section of the byte code & converting into native form of operating system.

In the current versions of java interpretation phase is very fast even compare with compilation phase. Due to this sun developer has populated java is one of the highly interpreted programming language.

Robust (Strong):-

→ Java is one of the strong programming language bcoz it contains a facility called exception handling.

→ The languages like C,C++,Pascal, COBOL etc & whose APIs are treated as weak bcoz these languages do not contain a facility called exception handling.

→ Whereas Java & whose APIs are treated as strong bcoz Java contains a error handling facility called Exception handling.

Q:- Define Exception? what is meant by Exception Handling?

→ Runtime error of Java program is known as exception.

→ Every exception of Java program generates by default system/technical error messages which are not understandable by API user. Hence industry is not recommended to generate system error messages. But recommended to generate user friendly error messages.

→ The process of converting system error messages into user friendly error message is known as exception handling.

Dynamic :-

(15)

In any programming language we have two types of memory allocation technologies. They are

- a. Static memory allocation
- b. Dynamic memory allocation

→ In static memory allocation memory space is created/allocated for input of the program at compile time.

Due to static memory allocation we get the following limitations.

1. Waste of memory space
2. Loss of data
3. Overlapping of existing data

To avoid these problems industry is highly recommended to follow dynamic memory allocation.

→ In dynamic memory allocation the memory space is allocated for input of program at runtime. Java programming follows only dynamic memory allocation. Sun developers has populated that Java is one of the dynamic programming language.

Secured :-

→ Security is one of the principle used in the industry projects for protecting confidential information from unauthorized users.

→ In Java Non-Java programming language (C, C++, Pascal etc)

there is no existing library for security.

→ Non Java language programmers needs to write their own code for providing the security & it may be complex hence every non Java Programming language is unsecured.

→ In the case of Java programming we have a dedicated API (library) for dealing with a security i.e., In Java projects

⑯ a java programmer need not to write any security program on their own & they can use readily available security program present in the existing API (like `java.security.*`)

Since it is containing readily available security API SUN developer has populated Java is one of the secured programming language

Data types:-

The purpose of datatypes is to allocate sufficient amount of memory space for the input of the program in the main memory of the computer either by following static memory allocation (or) Dynamic memory location.

In every programming language data types are classified into 3 types. They are

1. Fundamental/ pre-defined datatypes (primary/ primitive/core scalar/built-in)

2. Derived data types

3. User-defined/ secondary/ custom/ programmer/ Referential datatypes

Fundamental datatypes are those which are developed by language developers & supplied as a part of their softwares & whose variables allows us to store single value but they never allows us to store multiple values of same type.

Ex:-
int a;
a=10; // Invalid
a=10,20,30; // Invalid

⑦ Derived data types are those whose variables allows us to store multiple values of same type but they never allows us to store multiple values of different type.

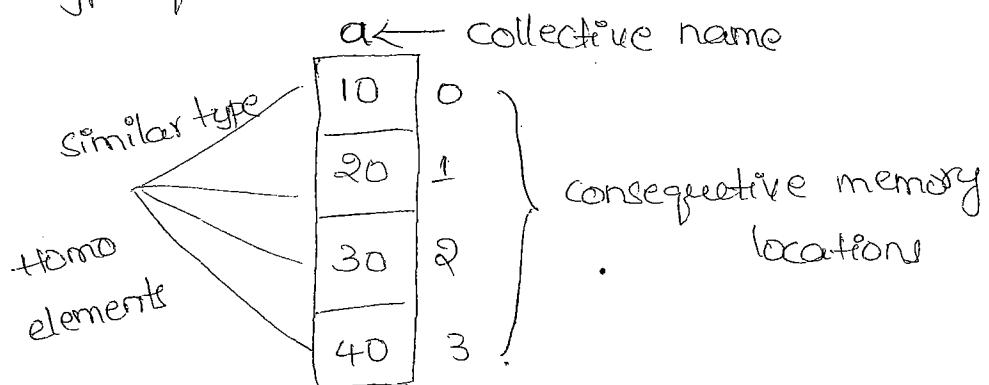
Ex:- `int a[] = { 10, 20, 30 }; // Valid`

`int b[] = { 10, 'A', 23.5 }; // Invalid`

In every programming language the concept of Arrays comes under derived data types.

Array:-

An array is a collective name given to a group of consecutive memory locations which are all referred by similar/homogeneous type of elements.



User defined data types are those whose variables allows us to store multiple values either of same (or) different types (or) both types by using language facilities.

Ex:- In 'c'-programming to create user defined datatype we use Structures (struct), Unions (union), Enumerations (Enum).

Similarly, in Java programming we use classes (class), interfaces (interface), Enumeration (Enum) etc. for development of user defined data types.

Ex:- `Student s0 = new Student();`

W	10	stno
S0	Kus	sname
	85.5	marks
	'A'	grade

(18) Java fundamental datatypes :-

In Java programming we have 8 fundamental data types which are classified into 4 categories. They are

1. Integer category datatypes
2. Float category datatypes
3. Character category datatypes
4. Boolean category datatypes

Integer category datatypes :-

- The aim of integer category datatypes is to store integer data in the main memory of the computer by allocating sufficient amount of memory space.
- Integer category datatypes contain 4 types & they are given in the below table.

S.NO	Datatype	size in byte	Range
1.	Byte	1	+127 to -128
2.	short	2	+32767 to -32768
3.	int	4	+x to -(x+1)
4.	long	8	+y to -(y+1)

→ If any category of data type contains multiple data types then it is mandatory to java program to choose an appropriate data type.

→ For choosing an appropriate data type we need to calculate the range of a data type. Range makes us to

④ Understand how much it can store at maximum & also how much it can store at negative code.

The following formula will be used for calculating range of any datatype.

Range of any datatype

$$= \left[\begin{array}{l} \text{The no. of bits available in the language which is understandable by computer} \\ \text{No. of bits occupied by a particular datatype} \end{array} \right] \text{ to the power of}$$

Ex:-

$$\begin{aligned} \text{Range of short datatype} &= (2)^{16 \text{ bits}} & 16 \text{ bits} = 2^4 \times 8 \\ &= 1 \text{ to } 65536 \\ &= 0 \text{ to } 65535 \\ &= +32767.5 \text{ to } -32767.5 \\ &= +32767 \text{ to } -32768 \end{aligned}$$

Float category Data types-

The basic aim of float category data types is to store real constant values (π) in the main memory of the computer by allocating sufficient amount of memory space.

This category contains 2 types of datatypes. They are given in following table.

Datatype	size (bytes)	Range	No. of decimal places
float	4	$+x \text{ to } (x+1)$	7

20) Float:

If we store any real constant values in a variable of float data type then such real constant value stored in the main memory in such away that after the dot(.) it takes 7 decimal places and the real constant value must be followed by a letter 'f' otherwise we get compile time error.

The following calculations shows IEEE 754 : Floating Point calculations how real constant values stored in the main memory in bit representation of float datatype

float $f_1 = 3.4f;$

f_1

$$\boxed{011.0110011}$$

 ↓
 7-decimal places

for 0.4:

$$\begin{array}{r} 0.4 \\ \times 2 \\ \hline 0.8 \\ \times 2 \\ \hline 01.6 \\ \times 2 \\ \hline 1.2 \\ \times 2 \\ \hline 0.4 \end{array}$$

 0
 1
 1
 0
 ↓
 for 3.4:
 for 3

$$\begin{array}{r} 3 \\ 2 \mid \\ 2 \mid 1 \\ \hline 0 \quad 1 \end{array}$$

 011
 011.0110

Double:

If we store any real constant value in a variable of double data type then the double datatype stores the real constant value in such away that after the dot(.) it takes 15 decimal places & a real constant value may/may not be followed by a letter 'd'.

Ex:- double d1 = 3.4d;

(or)

Q1

df

011.011001100110011

15 Decimal Places

In our Java program if we use any real constant value directly then such real constant value is by default treated as highest datatype in float category that is double datatype.

Float f1 = 3.5;

⇒ error

Becoz 3.5 is by default treated as double & it can't be directly stored in a variable of float type.

NOTE:-

In C-language

Ex:-

1. Float a = 3.4;

If (a == 3.4) double

{ PF ("OK"); }

else

{ PF ("CANCEL"); }

PF ("OVER");

ANS: CANCEL OVER

2. Float a = 3.5;

If (a == 3.5) double

{ PF ("OK"); }

else

{ PF ("CANCEL"); }

PF ("OVER");

ANS: OK OVER

This happens due to floating point calculator.

Ex:-

011.0110011 float

011.01100110011 double
which are not equal

Ex:-

011.0110000

011.1000000000000000

which are equal

→ A character is an identifier which is enclosed within single quotes.

Ex:- 'A', 'g', 'K', '\$' etc.

→ A collection of sequence of characters enclosed within double quotes is known as strings.

Ex:- "swap", "Jesus my lord", etc

Q:- TO store the character data in the main memory of the Computer in C, C++, Java programming we use a data type called 'char'.

→ Char data type in C, C++ takes 1 byte becoz C, C++ follows ASCII character set.

→ In Java programming char datatype takes 2 bytes becoz Java follows UNICODE character set. & Java programming is available in 18 International languages (English, Latin, Greek, etc)

Q:- Define ASCII & UNICODE

ASCII is a character set followed by those programming languages which are available in one International language called English & whose size is 256 ($2^8 = 256$) languages like C, C++, COBOL, follows ASCII character set as they are available in only English language.

UNICODE character set is one which is followed by those programming languages which are available in more than 1 International languages including English & whose size is 65536 characters ($2^{16} = 65536$)

Ex:- Java, .NET etc.

2 bytes

NOTE:- (Drawback of Java)

As per as English Java programmer is concerned for storing one character it requires one byte & rest of one byte is simply wasted which is one of the negligible drawback of Java language

③ Boolean category datatype :-

→ The aim of this category data type is to store logical values

(Feeling that they are existing but in reality they won't take physical memory space in main memory)

EX:- true, false.

→ In Java programming logical values are stored by using boolean

→ Boolean datatype of Java implemented by using a general purpose register called flip flop which will store one bit of memory space (1 for true & 0 for ~~false~~ false)

→ Boolean data type of Java takes 0 bytes of main memory space becoz boolean values are not storing in main memory but they are storing in registers called flip flops.

NOTE:-

→ Each & every keyword in Java must be written in small letters.

→ The default value of Integer category variables is zero(0)

→ The default value of Float category variables is 0.0.

→ The default value of Character category variables is nothing.

→ The default value of Boolean category variables is false

Q:- Why character category data types requires 1 byte memory space in C while 2 byte in Java.

As 'C' language supports only English language as it follows ASCII character set it requires single byte to store.

while Java uses UNICODE character set which supports International languages including English.

Consider in Latin A is represented as $\begin{matrix} \text{A} \\ \nwarrow 1 \text{ byte} \\ \uparrow 16 \text{ byte} \end{matrix}$

To store such letters 2 bytes are required

Variables

Importance of Variables :-

WKT by using data type we can allocate sufficient amount of memory space in the main memory of computer & values are also stored in the memory space. To process the values which are stored in the memory space, it is mandatory to the programmer to give or qualify some distinct name to the memory space. These distinct names are used for retrieving values from the memory space & these names are called Identifiers.

Identifier values are varying from one point of time to another point of time. So that identifiers are also known as variables.

Defn of Variable :-

A variable is an identifier whose values are changing during execution of the program.

Hence, to write a meaningful program we require to use variables in other words without variables we can't store the data in the main memory of the computer.

Rules for writing Variable:-

Out of so many no. of rules of variables, the following rules are suggested for writing variables

1. First letter of variables must be an alphabet.
2. In Java programming the length of variable can be upto 32 characters.
3. No special symbols are allowed except '_' (underscore)
4. NO Keywords to be used as variable names
(if, while, else, final)

Variable Declaration :-

Def:- The process of allocation sufficient amount of memory space by giving distinct names to memory space is called "Variable declaration".

*Without declaring variables we can't store the data

SYNTAX :- datatype V₁, V₂, ..., V_n ;

Here datatype represents either fundamental datatype

(a) derived (b) program defined datatype. V₁, V₂, ..., V_n represent JAVA valid variable names treated as name of the variables.

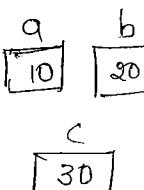
JAVA programming follows the declaration mechanism of C & C++ languages.

Ex:- Write the set of instructions for computing sum of 2 numbers.

C-Program declaration

```
int a,b,c;
a=10;
b=20;
c=a+b;
```

Declared at beginning of program



C++ program declaration

```
int a;
a=10;
int b;
b=20;
int c;
c=a+b;
```



Before using variable just declare before one line.

*The both languages must followed by JAVA.

(26) What happens when a variable is declared

int a;

1. Memory space created 4 bytes
2. Memory space giving name
3. Memory space giving address
4. Memory space zero is replaced by value.

Variable declaration cum Initialization

Def: The process of placing our own value without placing default value is known as

"variable declaration cum Initialization".

The purpose of initialization concept is that to place common values which are suitable for all the programmers.

SYNTAX :- datatype $v_1 = val_1, v_2 = val_2, \dots, v_n = val_n$

Ex:- float pi = 3.14f;

String crs = "JAVA";

① constants in JAVA :-

constant

def: A constant is a variable whose value can't be changed during execution of the program.

In JAVA programming to make anything as constant we use a keyword called "final".

The keyword final can be applied in 3 places

They are

1. At variable level
2. At method level
3. At class level

Final at variable level :-

At variable level it has two sub levels

a. Final at variable initialization:-

level

SYNTAX :- final datatype $v_1 = val_1, v_2 = val_2 \dots v_n = val_n$

once the initialized variable is made as final then modifications & assignments are not permitted.

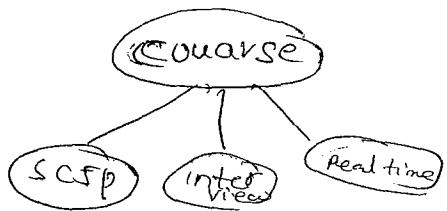
Ex:- `final float pi = 3.1417f;`

`pi = pi + 1; // Invalid`

`pi = 3.1417f; // Invalid`

b. Final at declaration level:-

SYNTAX :- final datatype $v_1, v_2 \dots v_n;$



(28)

Once the declared variable made as final then it allows first time assignment but it will not allow second & further subsequent assignments. & never allows ^{any} single modifications.

Ex:- `final float pi;`

`pi = pi + 1;` // Invalid

`pi = 3.1417f + 0;` // Invalid

`pi = 3.1417f;` // valid

`pi = 3.1416f;` // Invalid

Final variable values can't be modified.

2. Final at method level:-

In software development if we develop any funcⁿ which is common for all the programmers then such funcⁿs are called "constant funcⁿ" & whose defn must be made as final. Hence once the method is final it is not possible to re define/over write.

3. Final at class level:-

If we don't want to give features of base class to the derived class then the defⁿ of the base class must be made as final.

properties

Final classes never participates in inheritance

Q19(b)

Development of methods in JAVA:-

- In every prog. language for performing each & every type of operations we use the concept of functions.
- In JAVA prog. the concept of funcn is known as methods.

Defn of method :-

- A part of main program is called method. (or)
- subprgm of main prgm is called method.

Parts of the methods :-

Method development contains 3 parts. they are

1. Method call
2. Method definition
3. Method declaration / Method prototype

The purpose of method is performing the operation which is required in our project & it can be defined once & used by various programmers in many no.of place once & used by various programmers in many no.of place
Hence methods conveys a slogan called "Write once call anywhere!"

No.of approaches to define the methods in real time:-

1. → method can take the values & a method can return the values.
2. A method will not take the values & a method will not return the values

3. A method will not take the values & a method can return the values.

4. A method can take the values & a method will not return the values.

Syntax for defining a method in JAVA

Returntype method Name (list of formal parameters if any)

{

Block of statements (s) - Business logic

}

Explanation:-

1. Returntype represents type of value being returned by the method. If the method is not returning any type of value then its return type must be void.

Every datatype is a return type but return type is not a datatype

2. Method name represents a JAVA valid variable name treated as a name of the method. If a method name contains either one word or more than one word then first word 1st letter is small & rest of the subsequent words 1st letter must be capital.
Ex- getEmpDetails()

(31)

3. List of formal Parameters represents the variable names used for holding the values which are sending from method calls.

4. Block of stmts represents set of executable statements & they provides result of the method & it is known as business logic.

Method Method
Function defn = Forml heading + Full Method body

* write a method in JAVA for calculating sum of 2 numbers.

To define the above method we've 4 approaches

Approach 1: A method T.V & a method R.V

Method definition	Method call
<pre>int sum(int x, int y) { int z; // local variable z = x+y; return(z); }</pre>	<ul style="list-style-type: none"> ① int res1 = sum(6,7); ② int res2 = sum(10,20); ③ int res3 = sum(8,9);

Approach 2: A method is N.T.V & a method is N.R.V

Method definition	Method call
<pre>void sum() { int a=10; int b=20; int c=a+b; System.out.println(a+b+c); }</pre>	<pre>sum(); sum(); sum();</pre>

Approach 3: → method is not taking values &
→ method is returning the value.

Method defn

```
int sum()
{
    int a=10;
    int b=20;
    int c=a+b;
    return (c);
}
```

Method call

```
int res1 = sum();
int res2 = sum();
int res3 = sum();
```

Approach 4: → method is taking values &
→ method is not returning the values

Method defn

```
void sum(int x, int y)
{
    int z = x+y;
    print z;
}
```

Method call

```
sum (10, 20);
sum (5, 6);
sum (-5, -9);
```

* Define a method in JAVA for interchanging of two
values or swapping of 2 values.

Sol: To define the above method one is not recommended
to choose those approaches which are returning
the values. Recommended to choose those approaches
which are not returning the values.

Approach 2 :- A method is NTV & a method is NRV

Method defn	M	Method call
<pre> void swap() { int x=10; int y=20; x=x+y; y=x-y; x=x-y; cout<<x; cout<<y; } </pre>		<pre> swap(); swap(); </pre>

Approach 4 :- A method is TV & NRV

Method def	Method call
<pre> int swap(int x,int y) { x=x+y; y=x-y; x=x-y; cout<<x; cout<<y; } </pre>	<pre> swap(10,20); swap(2,3); </pre>

(26)

The following table gives no. of approaches to define the methods vs phases within the methods.

No. of Approaches to define methods No. of Phases in methods	Method T.V.G R.V	Method N.T.V.G N.R.V	Method N.T.V.G R.V	Method T.V.G N.R.V
	outside the method	inside the method	inside the method	outside the method
Input	outside the method	inside the method	inside the method	outside the method
processing	inside the method	inside the method	inside the method	inside the method
output	outside the method	inside the method	outside the method	inside the method

NOTE For each & every method call their must exist a method def" otherwise we get compile time error

Method overloading

Method overloading = Method name is same + Signature is different

Signature represents the following points

- No. of parameters
 - Type of parameters
 - Order of parameters
- } atleast one thing must be different

Ex: 1. sum (10, 20, 30);

2. sum (10, 20);

4. sum (10, 1.5f);
5. sum (1.5f, 20);

• Here sum (...) is called ⁽³⁵⁾ overloaded method.

• ~~At~~ At the time of overloading the method we never consider the return type but we consider always same method name with different signature.

• Method overriding :-

Method overriding = Method heading + Method body
is same + is different

Ex :-

void op(int x, int y)

{

int z = x+y;

Print x,y,z;

}

void op (int x, int y)

{

int k=x+y;

Print k,x,y;

}

→ Defined by one programer

→ ~~Defined~~ ^{overridden} by another

→ It is called original method

→ overridden method

"The process of re-defining original method multiple times for performing multiple operations is called method overriding."

* In SW development if we develop any common method for most of the programmers then they can use the common method but they should not change the defn of method and hence common methods must be final. In otherwise final methods can't be overridden.

NOTE:- A overloaded method may/may not be final

Ex:- Define a method for calculating simple interest.

```

final float
void si (float p, float t, float r);
{
    float si = (p*t*r) / 100;
    return (si);
}

```

Homework:-

- Define a method for calculating area of a circle
(area = πr^2)
- Define a method for calculating area of rectangle
(area = lxb)
- Define a method for calculating perimeter of circle & rectangle
- Define a method for calculating converting the temperature Celsius to Fahrenheit
- Define a method for finding biggest of two numbers.

OOPS features / principles:-

In real world to develop any project we need some type of langl tech which will satisfies some principles either procedure oriented principles (popz) or object oriented principles (oops). Based on the principles followed by languages/technologies, the languages are classified into two types.

1. Procedure oriented programming languages (popz)

POPL :-

(37)

EX:- Pascal, COBOL, ADA, Visual Basic, PERL, FORTRAN, C, Developed, 2000 etc.

If any PL satisfies OOPS then it is called POPL.

In real time we use POPL for developing projects related to SIS SW & projects related to APP II SW but not projects related to internet SW (distributed apps).

If we choose POPL for development distributed apps then we get the following limitations.

1. POPL possess (gives) platform dependency
2. In POPL the data is visiting b/w client & server side apps in the form of plain text but not in the form of ciphered text.
3. POPL gives poor security
4. In POPL the data is visiting b/w client & server side apps in the form of byte by byte & results in poor com.
5. In POPL the data is available around the fence & leads to redundancy (repetition) problem.

To overcome the above problems industry is highly recommended to use those PL's which will satisfy OOPS.

OOPL :-

(28)

Ex:- Small talk	C++	Refill
Lisp	JAVA	Ruby etc
object Pascal	.net	
object COBOL		Simula

If a PL satisfies OOPS then it is called OOPL

Advantages of OOPL in development of distributed

Applications (JAVA)

1. In OOPL gives platform independence.
2. In OOPL apps the data is visiting b/w client & server side apps in the form of cipher text/ encrypted form.
3. In OOPL apps we get fully security.
4. In OOPL apps data can be visiting b/w clients & server side apps all at once & results in effective com.
5. In OOPL app development there is avoid object & solves redundancy problem.

In order to say a particular language is object oriented it has to satisfy OOPS principles & they classified into 8 types. They are.

- (B9)
- 0. classes
 - 1. objects
 - 2. Data Encapsulation
 - 3. Data abstraction
 - 4. Inheritance
 - 5. Polymorphism
 - 6. Dynamic Binding
 - 7. Message passing

All the above OOPS principles are common to

all OOPL but their SYNTAX'S/IMPLEMENTATIONS are changing
from one OOPL to another OOPL.

Q3/6

Class :-

- classes concept is always used for development of user defined/programmer defined data types.
- While we are using classes concept for development of user defined datatype we use a keyword called "class".
- Each & every Java program must start with a concept of class. In other words without classes concept there is no Java Program.
- Each & every class name in Java can be treated as user/Programmer defined data type.

Definitions

The process of binding data members & associated methods in a single unit is known as class

(OR)

A class is a collection of ⁽¹⁾ data members & methods.

Whenever we define a class there is no memory space is created for the data members & methods ~~most~~ but memory space will be created for the data members & methods when we create an object wrt a class. Hence, all the classes contains logical existence & object contains physical existence.

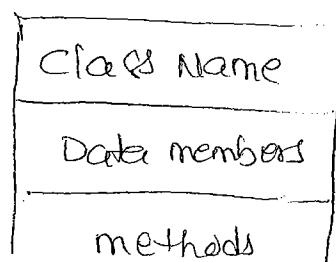
In object oriented programming we've 2 types of methods they are.

A. Member methods

B. Non-member methods.

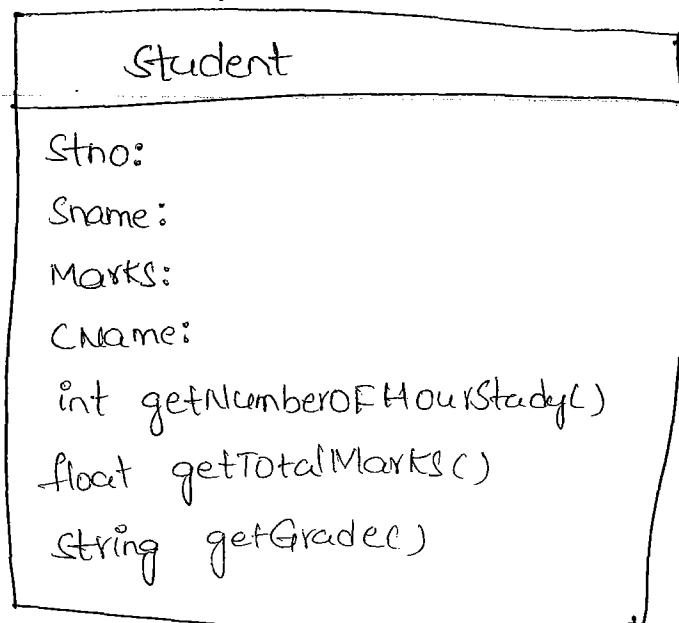
- A Member method is one which is defined inside the scope of the class & it can access the data of the class.
- A non-member method is one which is not available within the scope of the class & it can't access the data of the class.
- Java programming allows only member methods but not non-member methods.
- Data members of a class are known as Properties (or) fields (or) attributes. & methods are also known as Behaviour (or) Accessories.
- In real world apps development classes can be expressed by using class diagrams & they can be developed by using UML software like Rational Rose, Turbo Analyst (IBM products).

The structure of class diagram is:



Ex :- Draw a class diagram for student.

(4)



Syntax for defining a class in Java:-

Class classname

{

 variable declaration (data members)

 method definition

}

→ Class is a keyword used for developing user programmer defined datatype.

→ classname represents a Java valid variable name treated as the name of class. Each & every classname in Java is treated as userdefined datatype whenever we define a class there is no memory space is created for the data members & methods of a class but whose memory space is created when we create an object wrt class.

→ Variable declaration represents data members of a class & they will be selected depends on the name of a class.

→ Method definition represents set of methods meant for performing some specific operations & they will be selected depends on the name of the class. Each & every method in Java must be defined inside the class i.e., no method of Java to be defined outside the class.

→ The definition of the class must be incorporated within {} and
the definition of the class may/may not be terminated by ;)
Semicolon.

NOTE

If a class name contains either one word (or) more than one word then all words first letters must be capital.

Ex:- ActionEvent, NumberFormatException, Button etc.

Q:- Write a class definition for Student.

Class Student

{

int sno;

String name;

float m1, m2, m3;

int getNumberofHoursStudy()

{

return(2);

}

float getTotalMarks()

{

float tot = m1 + m2 + m3;

return(tot);

}

String getGrade()

{

return("Distinction");

}

} // Student

Q:- Write a class definition for computing sum of two numbers

Class Sum

{

int a, b, c;

void accept()

{

a = 10;

b = 20;

Sum

int a;
int b;
int c;

void accept();
void add();
void disp();

(43)

```
void add()
{
    c=a+b;
}
void disp()
{
    System.out.println("val of a=" + a);
    System.out.println("val of b=" + b);
    System.out.println("val of c=" + c);
}
//Sum
```

Object:-

- WKT when we define a class there is no memory space created for data members & methods of class but whose memory space is created when we create an object w.r.t class.
- In otherwords if we want to enter values of data members of the class first we have to allocate memory space for data members of class by creating its object.
- To create an object there must exist a class definition. without object creation data processing is not possible in Java based applications.

Details of object:-

1. Instance of a class is known as an object (Instance is nothing but allocating sufficient amount of memory space for data members & methods of a class).
 2. Each & Every class variable is known as an object.
 3. Each & every grouped item is known as an object.
 4. Real world entities are called objects.
 5. Blueprint of a class is known as an object.
- 1, 2 & 3 are recommended during interfaces & 4, 5 are not recommended

Creating an object in Java 44

Creating an object is nothing but allocating memory space for data members & methods of a class by following dynamic memory allocation by using new operator & it is known as dynamic memory allocation operator.

functions of new operator :-

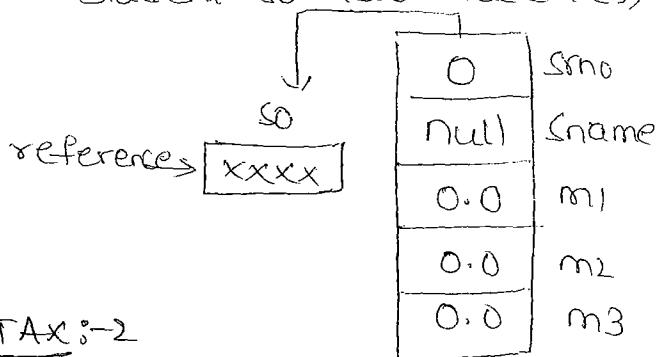
1. It allocates sufficient space for data members & methods of a class.
2. It takes an address/reference of a loaded class & place it into LHS variable i.e., object name.

To create an object with new operator we have 2 syntaxes.

Syntax:-1

```
<clsName> objname = new <clsName();>;
```

Ex:- Student s0 = new Student();



Syntax:-2

```
<clsName> objname;
```

```
objname = new <clsName();>;
```

Here statement 1 represents object declaration when ever an object is declared, memory space is not created for data members & methods of a class & whose default value is null.

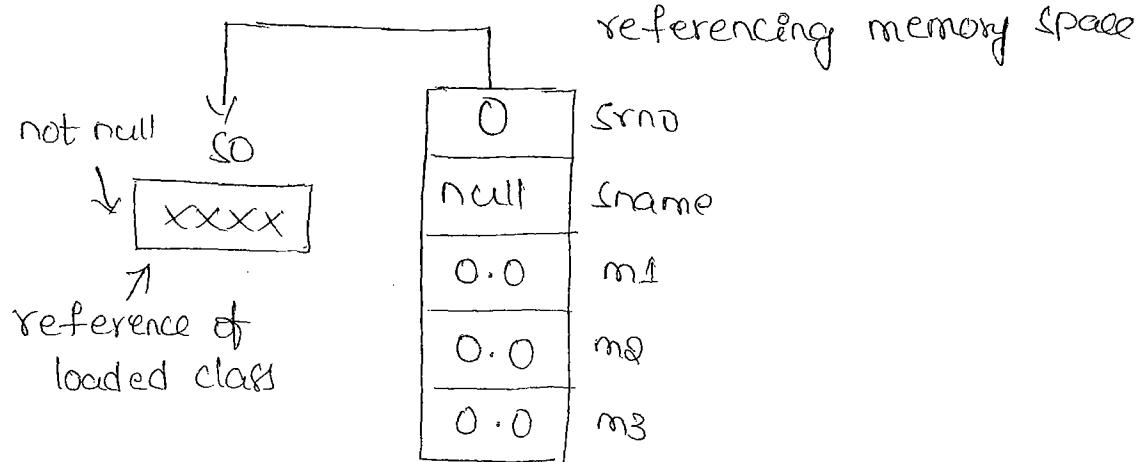
Student s0; // Student Object declaration



(45)

- Statement 2 represents object referencing. whenever an object is referenced memory space is allocated for data members of the class & whose default value is not null (which is nothing but reference/ address of loaded class)

`s0 = new Student(); // Student Object`



Q: Define a class loaded subsystem.

It is one of the program developed by SUN M/S & added as a part of Java S/W & whose role is to transfer or load the .class files from secondary memory (hard disk) into main memory (RAM).

classobject

1. A class is a collection of data i.e. Incidence of a class called members & associated methods. an object.
 2. Whenever we define a class memory space is not created for the data members & methods of a class.
 3. classes contains logical existence
 4. Definition of a particular class will exists only once
 5. Whenever we execute the JAVA program the defn of the class will be loaded in to main memory only once with the help of class loader sub. system.
 6. The defn of the class resides in secondary memory in the form of .class file.
1. When we create an object memory space is created for the data members & methods.
 2. Object contains physical existence
 3. W.r.t one class defn one can create multiple objects.
 4. After loading the class defn in the main memory whose objects will be created later.
 5. Objects of JAVA resides in main memory.

Note 1:

All the objects of JAVA programming resides in heap memory:

Note 2

All the methods of class/object which are .. in .. memory

Note:3

(47)

All the content/ figurative values resides in associative memory.

* All the above 3 memories are the parts of main memory.

Types of data members in JAVA

In JAVA programming we've 2 types of data members.

They are 1. Instance/non-static Data Members
2. Static Data members

IDM

1. IDM's are those whose memory space is created each & every time whenever an object is created.
2. IDM's are used for storing specific values.

3. Programmatically, IDM's declaration should not be preceded by "static" keyword.

4. SYNTAX:-

datatype v₁, v₂ ... v_n;

* Each & every IDM must be accessed w.r.t. object name.

SDM

1. SDM's are those whose memory space is created only once when the class defn is loaded in main memory irrespective of no.of objects are created.
2. SDM's are used for storing common values which are suitable for all the programs.

3. Programmatically, SDM's declaration must be preceded by "static" keyword.

4. SYNTAX:-

static datatype v₁, v₂, ... v_n;

* Each & every SDM must be accessed w.r.t. class name (even with object also)

[classname. static SDM name]

6. IDM values are not sharable (Q)
 7. IDM's are also known as "object level data members"
 8. OB (OLDIM)
6. EDM values are sharable
 7. EDM's are also known as "class level data members"
 8. CLDM

8. EX:-

```
int PIN;  
int Stno;  
String name;
```

8. EX:-

```
Static String CRS = "JAVA";  
Static String Capital = "Delhi";  
Static float PI = 3.14159;
```

Types of methods in JAVA:-

In JAVA programming we have 2 types of methods. They are

1. Instance/non static methods
2. Static methods

IM

1. IM's are meant for performing repeated/specific operations such as reading the records from files, reading the records from the database etc.

2. Programatically, IM's definition should not be preceded by static keyword.

3. SYNTAX:-

```
Returntype methodname(List  
of formal parameters  
{ if any  
} on and on.....)
```

SM

1. SM's are used for performing one time common operations. Such as opening the file, obtaining the data base connection.

2. Programatically, SM's definition must be preceded by static keyword.

3. SYNTAX:-

```
static Rettype methodname (list  
of formal parameters if  
any)
```

```
{ Block of statements }
```

- ④ 4. Each & every IM must be accessed w.r.t. object name.
- Objname.IM name ()
- ④ 4. Each & every SM must be accessed w.r.t. class name.
(Even with object also.)
- clsname.SM name ()
- ⑤ The result of instance method is not sharable.
- ⑥ The result of SM is sharable.

6. IM's are also known as "Object level methods".

6. SM's are also known as "class level methods"

7. EX:-

```
void calTotal()
{
    total = m1 + m2 + m3;
}
```

7. EX:-

```
public static void main ( )
{
    ==
    S1.calTotal ( );
    S2.calTotal ( );
    ==
}
```

* → A class of Java can contain IDM's, SDM's,

IM's & SM's.

* IDM's & IM's can be called wrt class name whereas SDM's & SM's must be called wrt object name.

c++ [OOP]

To display - result

cout ← object → ostream

↑
ostream

To read

cin ← object → istream

↑
istream

~~9/6/15~~

newline

System.out.println () → ①

System.out.print () → ②

(5)

- Statement ① is used for displaying the result of the JAVA program on the console line by line
- Statement ② is used for displaying the result of JAVA program on the console in the same line

Technical Description :-

- Here `println()` & `print()` are two pre defined overloaded instance methods present in a pre-defined class called PrintStream.
- To access `println()` & `print()` methods we need an object of `PrintStream` class.
- An object of `PrintStream` class called out is created at the static data member in another pre-defined class called `System`. Hence, to access `println()` & `print()` methods we use the following statements.

- i) `System.out.println()`
- ii) `System.out.print()`

consider the following code segment we gives view about

technical description of above ① & ② statements

class System

{

 static PrintStream out =
 new PrintStream

, ==

class PrintStream

{

 void println()

{

 ==

}

 void print()

{

 ==

2

(51)

→ EX :- Display "Hello Java world" msg

System.out.println("Hello Java world");

→ EX :- int a=10

System.out.println(a); // 10

System.out.printf("val of a = "+a); // val of a = 10
System.out.println("a" is the val of a); // 10 is the value of a

EX :- int a=10, b=20;

int c=a+b;

Public - universal access modifier

SOP ("sum = "+c); // sum = 30

SOP (c+" is sum"); // 30 is sum

SOP ("Sum of "+a+" and "+b+" = "+c); // sum of 10 & 20 = 30

Structure of the Java program :-

Main - Pseudo Method compile

The standard format developed language develops which is used by programmers is called "Structure of the program".

The following standard format used for developing JAVA apps

Packages inon;

Class <classname>

{

Data members

User defined methods

②

```
public static void main (String [] )
```

{

Block of `stmt ()`

}

}

① Package info represents collection of classes & interfaces & sub packages. A sub package internally contains collection of classes, interfaces & sub sub packages etc. If we use any pre-defined class or interface as a part of our Java program then it is mandatory to the Java programer to specify in which package the classes & interfaces presents otherwise we get compile time error. Out of many no. of packages in Java programming one package is by default imported known as "Java.lang.*".

② Each & every Java program must starts with a concept of class. Here, class is a keyword used to develop program defined data type.

③ <classname> represents a Java valid variable name treated as name of the class.

④ Data members represents either FDM or CM & they will be decided based on the class name.

⑤ User defined methods represents either IM or CM & they will be decided based on the class name.

- ⑥ → Each & every Java program starts executing from main method & it is called Program driver (pseudo method)
- ⑦ → Since main method of Java is not returning any value & hence its ret-type must be void.
- ⑧ → Since main method of Java executes only once in the entire life of the Java program & hence its nature must be static:
- ⑨ → Since main method of Java accessed by all the Java programmers & hence while no access modified must be public.
- ⑩ → Every main method of Java takes array of objects of strings
- ⑪ → Block of stmts represents set of executable stmts which are internally calls user defined methods of the class.
- ⑫ → The file naming convention in Java programming is that whatever the class is containing the main method, it should be given as a file name with an extension

• Java:

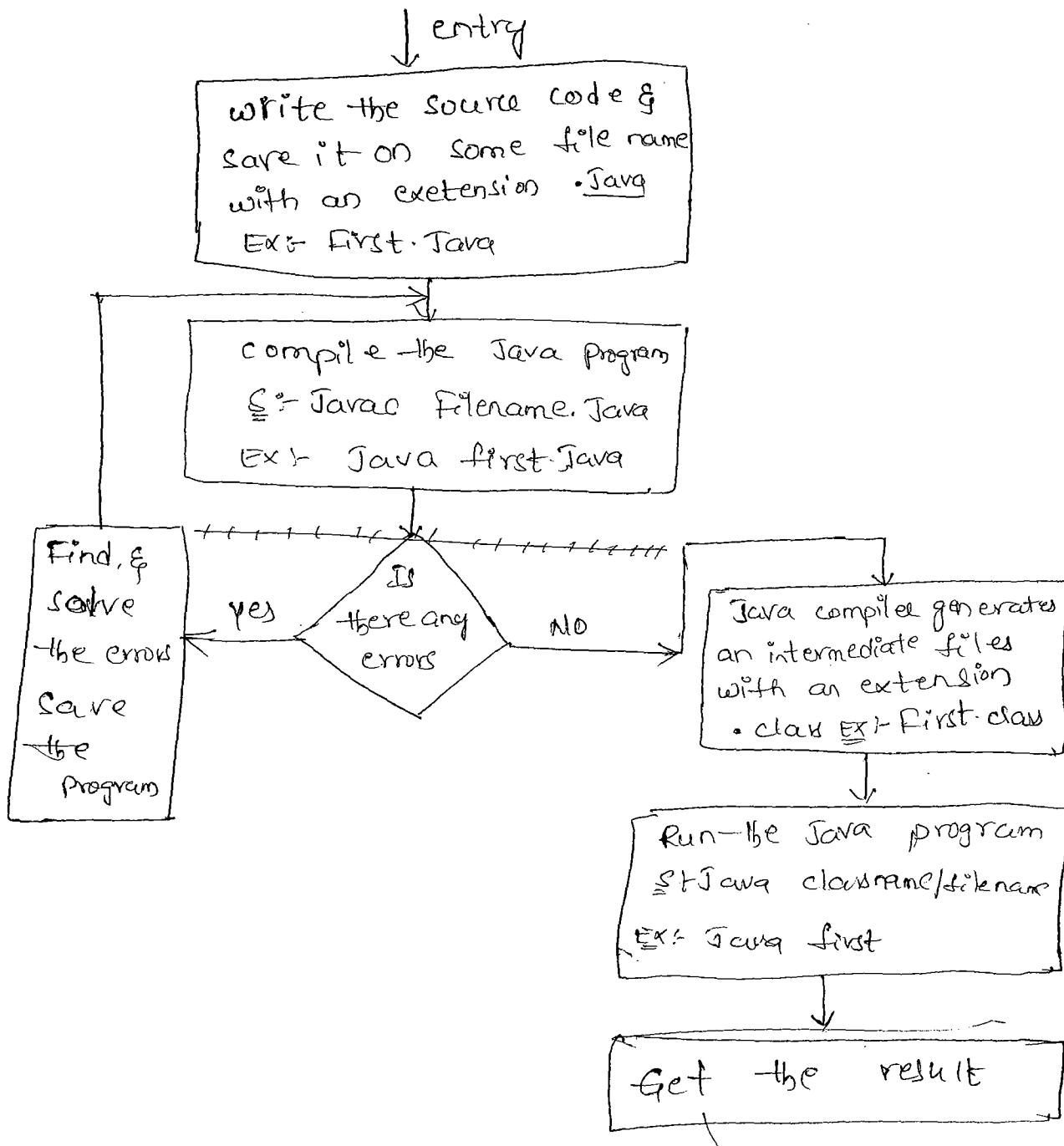
* write a Java program which will print "Hello Java world".

```
// first.java
class First
```

```
{}
public static void main (String args[])
{
    System.out.println("Hello Java world");
    System.out.println("This is my first program");
}
```

Compiling & Running the Java Program :-

The following diagram gives sequence of steps for compiling & executing the Java program.



In the above diagram Javac & Java are called tools
 (a) app programs (b) exe files developed by sun micro sys
 developers & supplied at the part of
 JAVA - HOME / bin directory & whose purpose is

(55)

Requirement analysis for developing Java project / epon 8-

1. Software Requirement

Download JDK 1.5, 1.6 or 1.7 / 1.8 from www.sun.com / www.oracle.com freely.

2. OS Requirement

Any OS becoz Java is platform independent language.

3. IDE Requirement (Integrated Development Environment)

An IDE is the one of the 3rd party SW developed by 3rd party SW Vendors, released to the real Industry & used by the all programmers for development of different apps by making use of In-build comforts.

EX

a. DOS Editor,
Note Pad,
Word Pad etc } Poor IDE
Industry will not use

b. Edit Plus - ES Enterprise } Poor IDE
Industry will not use

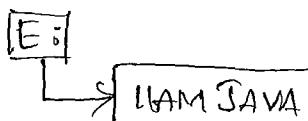
c. Net Beans

Eclipse
MyEclipse
WSAD
IntelliJ IDEA
RAD etc } Effective IDE's
-
used in real
Industry

Setting the Path for Compiling the Java Program:

1. Create a directory (E:\IAMJAVA) & save the a filename in this directory

EXT



JVM - Java
virtual
Machine

→ First.java

2. Compile the Java program

E:\IAMJAVA>javac First.java

→ we get error becoz Javac doesn't exist in IAMJAVA. Inorder to use Javac tool as the part of our directory we must set the path to the location where Javac present.

E:\IAMJAVA>set path = D:\Java\Jdk1.6\bin

→ Recompile the above program after setting the path

E:\IAMJAVA>javac First.java

→ Ensure that Java compiler generates first.class.
In general .class file will be generated based on class defn but not on file name.

3. Run the Java program

E:\IAMJAVA>java First

→ when the above Stmt is executed internally
the following 4 operations will takes place.

i) class loader sub sys loads/transfers first.class into main memory from secondary memory.

- ii) JVM stakes loaded class (First-class). (57)
 iii) Java looks for main method to starts its execution.
 iv) JVM will call the main method w.r.t the loaded
 class first.class as first.main()
 → 29/6
 * Write a Java program which illustrate the concept
 of method chaining.

Defn of Method Chaining :-

The process of establishing the connection b/w multiple methods for performing some operation is called "method chaining".

Class Third

{

void show()

{

System.out.println("show() - instance");

write(); //Rule-2

}

static void disp()

{

System.out.println("disp() - static");

}

void write()

{

Third. disp(); //Rule-4

(3)

```
System.out.println ("write () - instance");
```

{

```
public static void main (String [] args)
```

{

```
System.out.println ("I am from main () - beg");
```

```
Third t1 = new Third();
```

```
t1.show (); // Rule-3
```

```
disp (); // Rule-1
```

```
System.out.println ("I am from main () - End");
```

}

}

Method chaining Rules :-

Rules 1

one static method can call another static method directly provided both the static methods belongs to same class.

Rules 2

one IM can call another IM directly provided both the IM's belongs to same class.

Rules 3

one SM can call another SM directly w.r.t Object without considering wheather they belongs to same class.

Rule 4

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- one IM can call another SM w.r.t. class name
- without considering whether they belongs to same class (or) different class.

Q Can we write multiple main methods in Java

Ans - Yes,

In one Java program we can write multiple main methods where name of the method is same but whose signature is different i.e., overloaded main methods can be defined.

NOTE:- The following code gives overloaded main methods

1 Exam.java

class Exam

{

 public static void main (float x) // — (3)

{

 System.out.println ("I am from main() - taking float param");

}

 public static void main (String k[]) // — (4)

{

 System.out.println ("I am from main() - taking array of objects");

 main (10); // control goes to (2)

}

public static void main (int) 11-(3)

{

System.out.println("I am from main() - feeling int Pareto")

main(1.5f); // control goes to (3)

}

} 11 Exam- class

NOTE: It is not possible to define duplicate method defns which is already existing with same RetType & same signature.

* write a Java program which will compute multiplication of 2 numbers.

11 MulDemo.java

class Mul

{

int a,b,c;

void read()

{

a=6;

b=5;

}

void multiply()

{

c=a*b;

}

```

(61)
1 - void disp()
2 {
3     System.out.println("a" * "b" + "c");
4 }
5 } // Mul-BLC
6 class MulDemo
7 {
8     public static void main(String[] args)
9     {
10        System.out.println("i am from main() - beg");
11        Mul m = new Mul();
12        m.read();
13        m.multiply();
14        m.disp();
15        System.out.println("i am from main() - end");
16    }
17 } // MulDemo

```

If we run the above program we get same O/P in all the times. If we want to get different results we must do the following cyclic steps.

1. go to the program
2. Change the required values
3. Save the Program
4. compile the Program

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If any program satisfies the above characteristics then it is called "static programming/hard coded approach" which is not a recommended process in software development bcoz app users may not be able to perform the above steps.

Hence, programmers must always develop "dynamic programming/flexible approach."

Q: Define hard coded Approach & flexible Approach.

Ans - In the I/O of the program mentioned in the program participated during compilation time & used at execution time.

In R/A/I/O of the program supplied at run time & used at run time & it is the highly recommended process.

Accepting the Values dynamically to the Java program

In Java programming we can accept the data dynamically by using 4 approaches. They are

1. By using command prompt
2. By using Keyboard
3. By using properties file/resource bundle file
4. By using XML Document

Length: Length is one of the Implicit variable created by JVM & supplied to each & every Java program for 2 purposes -
1. To get the length of string
2. To get the length of array

Q 1. It is used to find no. of elements present in arrays
i.e., size of the array.

2. To treat fundamental arrays (int[], float[] etc)
as objects internally by the JVM.

Ex :- 1

int a[] = {10, 20, 30};
System.out.println("No. of elements = " + a.length); // 3

for (int i=0; i < a.length; i++)

{

 System.out.println(a[i]);

}

Ex :- 2

float x[] = {1.9f, 2.5f};
System.out.println("No. of elements in x = " + x.length); // 2

for (int i=0; i < x.length; i++)

{

 System.out.println(x[i]);

}

Ex :- 3 array of objects of string class

String s[] = {"c", "CPP", "Java"};

System.out.println("No. of courses = " + s.length); // 3

for (int i=0; i < s.length; i++)

{
 System.out.println(s[i]);

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1. Accepting the data dynamically from command prompt

Consider the following statement

E:\HIM\Java> Java MulDemo 10 20
command prompt Java program values

The no. of values passing to the Java program
The no. of values passing to the Java program
from cmd prompt are called cmd line arguments
When the above stmt is executed the following
steps takes place internally.

- (i) class loader sub s/s loads / transfer MulDemo into main memory along with cmd line arguments (Ex:- 10 20)
- (ii) JVM takes loaded class MulDemo along with cmd line arguments (Ex:- 10 20) & counted them. [Ex-> length⁽²⁾ string K⁽²⁾[length]]
- (iii) JVM looks for the main method ('String K[2]') w.r.t loaded class MulDemo. as MulDemo.main(String K[2])

Ex :-

E:\HIM\Java> Java StudentDet 10 scathy JNU 79

StudentDet. main(String K[4])
for(int i=0;i<K.length();i++)
{
 System.out.println(K[i]);
}

10	0
scathy	1
JNU	2
79	3

* write a Java program which will accept cmd line args
& display those values on the console.

11 DataRead.java

class DataRead

{

public static void main (String K[])

{

Sop ("no. of cmd line args = " + K.length);

for (int i=0; i < K.length; i++)

{

Sop (K[i] + " ");

for our own spacing

}

}

}

compile the above program

Java DataRead.java

Ensure DataRead.class file must be generated

RUN the Java program by passing cmd line args

Ex:- Java DataRead 10 Sathya JNTU

output :

No. of cmd line args

10

Sathya
JNTU

17 converting string type data into numerical/fundamental type data :-

W.R.T whatever the cmd line arguments we pass to the Java program, they are taken by JVM & placed in main method & available in the form of array of objects of String class. W.R.T on string type data it is not possible to perform numerical operations & hence it is highly desirable to convert string type data into fundamental numerical type data.

The following table gives fundamental data type, corresponding wrapped class name & conversion method which will convert numerical string type data into numerical/fundamental type data.

Fund Data types	wrapped class Name	conversion method which will convert numerical string type data into Num/Fan type
byte	Byte	public static byte parseByte (String)
short	Short	public static short parseShort (String)
int	Integer	public static int parseInt (String)
long	Long	public static long parseLong (String)
float	Float	public static float parseFloat (String)
double	Double	public static double parseDouble (String)
char	Character	—
boolean	Boolean	public static boolean parseBoolean (String)

In general each & every wrapped class (except character) contains the following predefined generalized method

Wrapper class name ↴

public static xxx parsexxx(String)

Here xxx represents any fundamental data type
(except char datatype)

Q: What r the 3 points to be remember for using Java methods from Java API in Java program.

1. Decide what type of method we r using (either IM or SM) & present in which class.
2. Decide what type of parameter a method is using & pass its value
3. Decide what type of return type a method is returning & hold the result in a variable of that type. (ret.type)

Ex:- String s₁ = "10";

String s₂ = "20";

Sop(s₁+s₂); // 1020

int x = Integer.parseInt(s₁);

int y = Integer.parseInt(s₂);

int z = x+y;

Sop("sum = "+z); // 30

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Sop("sum= "+x+y); //1020

Sop("sum= "+(x+y)); //30

Sop("sub= "+x-y); //error

Sop("sub= "+(x-y)); //10

Sop("mul= "+x*y); //200

Sop("Div= "+x/y); //0

Sop("Rem= "+y%x); //0

Sop("Rem= "+x%y); //10

* write a Java program which will calculate multiplication
of 2 numbers from by accepting 2 integer values from
command prompt.

1) MulDemo1.java

```
class Mul
{
    int a,b,c;
    void read(int x,int y)
    {
        a=x;
        b=y;
    }
    void multiply()
    {
        c=a*b;
    }
}
```

```
①
②     void display()
③     {
④         System.out.println(a + " * " + b + " = " + c);
⑤     }
⑥ }
```

// MUL-BLC

class MulDemo1

{

public static void main (String [] args)

{

// accepting cmd line args & converting into int type

int x = Integer.parseInt(args[0]);

int y = Integer.parseInt(args[1]);

→ System.out.println ("I am from main() - beg");

// create an object of BLC

Mul m = new Mul();

// send the dynamic values

m.read (x,y);

m.multiply();

m.disp();

System.out.println ("I am from main() - 'end'");

→ compile above program

javac MulDemo1.java

→ Run the Java program by passing 2 cmd line args

Java MulDemo1 5 6

** ~ ~ ~

Q10: Define a wrapped class? What is its purpose.

Ans): For each & every fundamental data-type there exist pre-defined class & it is known as wrapped class.

The purpose of wrapped classes in Java is that converting numerical string type data int numerical fundamental type data.

* Write a Java program which will accept 2 integer values & swap them.

11 SwapDemo.java

```
class Swap
{
    int a,b;
    void read()
    {
        int a=x;
        int b=y;
    }
    void swapvalues()
    {
        a=a+b; // int t=a
        b=a-b; // a=b
        a=a-b; // b=a
    }
}
```

```

• void disp()
• {
•     sop("values of a = "+a);
•     sop("values of b = "+b);
• }
• } // BLC

class SwapDemo
{
    public static void main (String k[])
    {
        if (k.length != 2)
        {
            sop ("plz enter two values");
        }
        else
        {
            // accepting cmd line args & converting into final values
            int x = Integer.parseInt(k[0]);
            int y = Integer.parseInt(k[1]);
            Swap so = new Swap();
            so.read(y);
            sop ("original values");
            sop ("_____");
            so.disp();
            sop ("_____");
            so.swapValues();
        }
    }
}

```

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```
SOP("Swapped values");
```

```
SOP("____");
```

```
so.disp();
```

```
SOP("____");
```

```
} // else
```

```
{//main()
```

```
} // Swap Demo - ELL
```

* Write a Java program which will compute ~~square~~
of a given number. Take the number from the cmd
prompt.

// SquareDemo.java

```
class square
```

```
{ int n;
```

```
void set(int x)
```

```
{
```

```
 n=x;
```

```
}
```

```
void squareCall()
```

```
{
```

```
 int res = n*n;
```

```
 return res;
```

```
}
```

```
void disp()
```

```
{
```

```
 int r = squareCall();
```

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```

3 // square- BLC
class SquareDemo
{
    public static void main (String [] args)
    {
        if (args.length != 1)
        {
            System.out.println ("plz enter one value");
        }
        else
        {
            int x = Integer.parseInt (args[0]);
            Square so = new Square();
            so.set (x);
            so.disp ();
        }
    }
}

```

* Write a Java program which will decide whether
the given number is +ve or -ve or zero.

// NumberDecide Demo1. Java

class NumberDecide

```

{
    int n;
    void set (int x)
    {
        n = x;
    }
}
```

String decide()

{

String s = " ";

if (n > 0)

{

s = n + " is +ve";

}

~~else~~

~~if (n < 0)~~

{

if (n < 0)

{

s = n + " is -ve";

}

else

s = n + " is zero";

}

|| else
return s;

}

void disp (String z)

{

sop (z);

}

|| Number decide - SLC

```

class NumberDecideDemo1 {
    public static void main (String [] args) {
        if (args.length != 1)
            System.out.println ("please enter only one value");
        else
            {
                int m = Integer.parseInt (args [0]);
                NumberDecide no = new NumberDecide ();
                no.set (m);
                String res = no.decide ();
                no.display (res);
            }
    }
}

```

NOTE:- A method of Java is not only returning fundamental types (values) but also returns class name as a return type.

NOTE! → A method of Java is not only taking fundamental types as parameter but also takes class type names as parameters (objects as parameters)

- * write a Java program which will calculate area
 of a circle by accepting radius from cmd prompt
- * write a Java program which will calculate area
 of rectangle by accepting length & breadth from cmd prompt

// Areademo.java

class Area

{ int r;

void set (int x)

{

r=x;

}

void areacircle()

{

float a = 3.1417f * r * r;

}

void disp()

{

System.out.println("area of circle = " + a);

} // Area - BLC

class Areademo

{

public static void main (String K[])

{

if (K.length != 1)

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```

    {
        SOP("Plz enter one value");
    }
    else
    {
        int x = Integer.parseInt(K[0]);
        Area A0 = new Area();
        A0.set(x);
        A0.areaCircle();
        A0.disp();
    }
}
// main
}
// Areabemo - ELC

```

* // Areademo1.java

```

class Area
{
    int l, b;
    void set(int x, y)
    {

```

$x = r$; $l = x$;
 $y = b$; $b = y$;

}

void arearect()

{

$$a = l * b;$$

}

Void display()
{
 SOP("d+ " + b + " + a);
}

} // Area - BLC

Class AreadeMO1

{
 Public static void main(String K)
{

 if (K.length != 2)

 {
 SOP("plz enter two values");
 }

 else

 {
 int x = Integer.parseInt(K[0]);
 int y = Integer.parseInt(K[1]);
 Area A0 = new Area;

 A0.set(x, y);

 A0.areaRect();

 A0.display();

 } // else

} // main

} // ELC.

- 317
79
- Q * Write a Java program which will print 1 to n members by accepting n-value from user prompt.

→ NOTE: In every programming language we use control structures for performing either same operation or some other operation only once depends on the condition evaluation or perform some operation repeatedly until condition becomes false.

control Structures Condition contains

(a) conditional stmts (if, if else, switch) are used for performing either one operation or some other operation only once.

(b) looping stmts (while, do while, for) are used for performing some operation repeatedly until condition becomes false

To deal with looping kind of program we need to ensure 3 parts must present in our program. They are

- Initialization part
- Conditional part
- Updation part (incrementation / decrementation)

prgm:- ~~Alphabets~~

(8)

1) NumGenDemo.java

```
class Number  
{  
    int n;  
    void set(int x)  
    {  
        n=x;  
    }  
    void generate()  
    {  
        if (n<=0)  
        {  
            System.out.println("plz enter +ve value");  
        }  
        else  
        {  
            for (int i=0; i<=n; i++)  
            {  
                S.O.P(i);  
            }  
        } // else  
    }  
} // NumGen - Blc
```

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```

class NumberDemo
{
    public static void main (String [] args)
    {
        if(args.length != 1)
        {
            System.out.println("please enter one value");
        }
        else
        {
            int x = Integer.parseInt(args[0]);
            Number no = new Number();
            no.set(x);
            no.generate();
        }
    }
}

```

* Write a Java prgm which will accept a number
 integer from the cmd prompt & generate multiplication
 table.

// MultiplicationDemo.java

class Multiplication

```

{
    int n;
}
```

Void set(int x)

(2)

n=x;

}

Void table()

{

If (n<=0)

{

SOP ("plz enter the value");

}

else

{ int ~~a=n*10~~; SOP ("multiplication table for " + n);
SOP (" = " + " " + " " + " " + " " + " " + " " + " " + " " + " ");

for (int i=1; i>=10; i++)

{

SOP (" + n * " + i + " = " + a);

}

→ SOP("n")

} // else

}

} // BLC

class MultiplicationDemo

{

public static void main(String[] args)

{

If (args.length != 1)

{

SOP ("plz enter one value");

```

    else
    {
        intx = Integer.parseInt(args[0]);
        intx = Integer.parseInt(args[0]);
        Multiplication m = new multiplication();
        m.set(x);
        m.table();
    } // else
} // main
}

```

* Write a Java program which will convert ordinary ~~number~~ into Roman number.

Logic Analysis :-

10 - X - W

9 - IX - if

5 - V - if

4 - IV - if

1 - I - W

100 - C - W

90 - XC - if

50 - L - if

40 - XL - if

1000 - M - W

900 - CM - if

500 - D - if

400 - CD - if

// RomanDemo.java

class Roman

{

int n;

void set(int x)

{

n = x;

}

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void convert()

{

if ($n \leq 0$)

{

SOP("No. Roman Eqn");

}

else

{

while ($n >= 1000$)

{

COPrint(" M");

$n = n - 1000;$

if ($n >= 900$)

{

COPrint(" CM");

$n = n - 900;$

}

if ($n >= 500$)

{

COPrint(" D");

$n = n - 500;$

}

if ($n >= 400$)

{

SOPrint (" CD");

$n = n - 400;$

```

while (n >= 100)
{
    soprint("c");
    n = n - 100;
}

if (n >= 90)
{
    soprint("xc");
    n = n - 90;
}

if (n >= 80)
{
    soprint("xL");
    n = n - 80;
}

if (n >= 40)
{
    soprint("XL");
    n = n - 40;
}

while (n >= 10)
{
    soprint("x");
    n = n - 10;
}

if (n >= 9)
{
    soprint("ix");
    n = n - 9;
}

```

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```

if (n >= 5)
{
    soprint("v");
    n = n - 5;
}

if (n >= 4)
{
    soprint("iv");
    n = n - 4;
}

if (n >= 1)
{
    soprint("i");
    n = n - 1;
}

} // convert
} // BLC

```

```

class RomanDemo
{
    public static void main(String[] args)
    {
        if (args.length != 1)
            sop("plz enter one value");
        else
            int x = Integer.parseInt(args[0]);
            Roman r = new Roman();
            r.print();
    }
}

```

r.convert();

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} // else

} // main

} // ELL

4.1 Concepts Constructors in Java :-

In Java programming constructors will have a separate role for in writing the program.

Def :- A constructor is one of the special member methods & it is automatically/ implicitly called by the JVM for placing during object creation time for placing our own values without placing default values.

Advantages of Constructors :-

When we develop the Java application with the concept of constructors then such apps will get the following advantages.

1. Constructors eliminates default values

2. Constructors eliminates in calling ordinary methods.

In otherwords, the purpose of constructor concept is to initialize the object.

Rules / Properties / Characteristics of Constructors :-

1. Constructors will be called implicitly/ automatically during object creation time.

- 2. Each & every constructor name must be similar to class name.
- 3. Constructors will not return any value even void also (if we write any return type then it will be treated as an ordinary method.)
- 4. Constructors should not be static (Becoz whenever an object is created constructors will be called each & every time)
- 5. Constructors of Java programming will not participate in inheritance process. (Becoz every constructor is meant for initializing its own class data members)
- 6. The access modifier (AM) of the constructor may or may not be private
 - a) If the AM of the constructor is private then an object of the corresponding class can be created in the same class context & it is not possible to create in the context of some other class.
 - b) If the AM of the constructor is not private then we can create an object of corresponding class in the same class context & in another class context.

Types of constructors in Java (8)

In Java programming we've 2 types of constructors.

They are 1. Default / Parameter less/ zero argument constructor

2. parameterized constructor

6/7/15

Default constructor :-

A constructor is said to be default if & only if

it will not take any parameters. The purpose is

The purpose DC is to create multiple objects with

same class for placing same values.

Syntax:-

```
class ClassName)
```

```
{
```

```
<classname>()
```

// Default constructor

```
{
```

```
    Block of Statement -- initialization
```

```
}
```

```
}
```

Q) * Write a Java program which illustrate the concept of default constructor.

1) TestDemo.java

class Test

{

int a,b;

Test() { DC }

System.out.println("Test DC");

a=1;

b=2;

System.out.println("val of a = "+a);

System.out.println("val of b = "+b);

}

} // BLC

class TestDemo

{

public static void main(String[] args)

{

Test t1 = new Test();

t1	9
2	b

Test t2 = new Test();

t2	9
1	b

Test t3 = new Test();

1	9
2	b

} // main

} // ELC

Rules :-

b) Whenever we create an object only with DC then defining the DC is optional.

c) Whenever we create an object with default constructor & if we are not using a then JVM will call its own DC known as "self defined DC".

and whose role is to place default values.

b) If we create an object with DC & if we define the DC then JVM will execute programmer defined default constructor & places programmer defined values.

Parameterized Constructor :-

A constructor is said to be parameterized iff only if constructor name is same always takes parameters.

The purpose of PC is that it always takes parameters & create multiple objects wrt same class for placing different values.

Syntax:-

class <cls names

{

 <clsnames (list of formal Parameters)

{

 Block of statements = Initialization

}

* Write a Java program which illustrate the concept of PC.

// TestDemo.java

class Test

{

 int a, b;

 Test(int x, int y)

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```
SOP("Test - DPC");
a=10;
b=20;
SOP("Val of a = "+a);
SOP("Val of b = "+b);
```

3 // Test

3 // BLC

Class TestDemo

{

public static void main (String [] args)

{

Test t1 = new Test (10,20);

Test t2 = new Test (100,200);

Test t3 = new Test (1000,2000);

3 // main

3 // ELC

Rule :- 2

When we create an object with PC then defining PC is mandatory otherwise we get compile time error.

Rule :- 3

Whenever we create multiple objects with both DC & PC then it is mandatory to the Java programmer to define both DC & PC. otherwise we get compile time error.

NOTE :- If we are ~~not~~ initializing data members of any class wrt corresponding class constructors then the uninitialised data members will be initialized by its defined default constructor with default values.

Overloaded constructor:-

A constructor is said to be overloaded if & only if constructor name is same but signature is different.

Signature represents the following points.

- (a) No. of Parameters
 - (b) Type of Parameters
 - (c) Order of Parameters
- } Atleast one thing must be different

EX)-

Test t₁ = new Test(10, 20); → ①

Test t₂ = new Test(100); → ②

Test t₃ = new Test(1.5f, 2.5f); → ③

Test t₄ = new Test(10, 1.5f); → ④

Test t₅ = new Test(1.5f, 20); → ⑤

Here Test(..) is known as overloaded constructor.

Object parameterized constructor :-

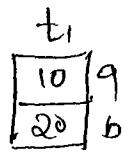
A constructor is said to be object parameterized if & only if it always takes object as a parameter.

The purpose of object parameterized constructor is that to copy the content of one object into another object where both the objects belongs to same type.

Q) The functionality of OPC is resembling the functionality of copy constructor of C++.

Ex:-

Test t₁ = new Test(10, 20);



Test t₂ = new Test(t₁);

OPC call

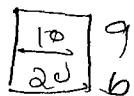
OPC
defn

Test (Test x)

{

a = x.a;
b = x.b;

}



* Write a Java program which illustrate the concept of DC, OPC & OPC

/*TestDemo.java

class Test

{

 int a,b;

 Test()

{

 System.out.println("Test _____ DC");

 a=1;

 b=2;

 System.out.println("val of a = "+a);

 System.out.println("val of b = "+b);

}

Test (int x)

⑨④

{

SOP ("Test — spc");

a = x;

b = x;

SOP ("val of a = "+a);

SOP ("val of b = "+b);

}

Test (int x, int y)

{

SOP ("Test — DPC");

a = x;

b = y;

SOP ("val of a = "+a);

SOP ("val of b = "+b);

}

Test (Test x)

{

SOPC ("Test — singleOPC");

a = x.a;

b = x.b;

SOP ("val of a = "+a);

SOP ("val of b = "+b);

}

test(testx1, testx2)

⑨3

{
sop "test — double opc";

a = x1.a + x2.a;

b = x1.b + x2.b;

sop ("val of a is" + a);

sop ("val of b is" + b);

}

} // BLC

class TestDemo

{

public static void main(String args){}

{

Test t1 = new Test();

Test t2 = new Test(100);

Test t3 = new Test(t2);

Test t4 = new Test(t2,t3);

}

} // Main

* Write a Java program for concatenating the content of
2 objects which are containing string data.

//Started JAVA

class Sathya

{

 String x, String y;

 Sathya(string s1, string s2) // PC

{

 x=s1;

 y=s2;

}

 Sathya (Sathya x1, Sathya x2) // OPC

{

 x=x1.x + "—" + x2.x;

 y=x1.y + "—" + x2.y;

}

 void disp()

{

 System.out.println("val of x=" + x);

 System.out.println("val of y=" + y);

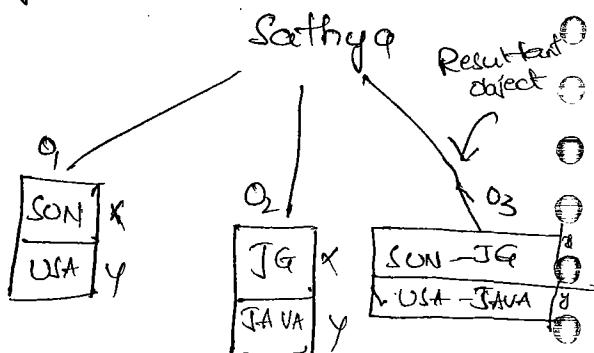
}

}

Java OPCD

{

 public static void main (String [] args)



(97)

Sop("First object values");

Sathyas O₁ = new Sathyas ("SUN", "USA");

O₁.disp();

Sop("Second object Values");

Sathyas O₂ = new Sathyas ("TG", "JAVA");

O₂.disp();

Sop("Resultant object Values");

Sathyas O₃ = new Sathyas(O₁, O₂);

O₃.disp();

} main

} IELC

Points to be Remembered:-

Where
DC - Default constructor
PC - Parameterized constructor
OLC - Overloaded constructor

1. By default every class of Java contains single default constructor (DC) known as "it's defined DC".
2. Programmatically, a class of Java can contain single DC defined by the programmer & multiple PC's known as "OLC's".
3. WKT a class of Java can contain collection of data members, constructors, methods etc & these details of the class are called profile. To view the profile/interface of a class we use a tool called Javap which is present in Jdk/bin folder.

SYNTAX:-

(18)

- a. Java -> classfile name
 - b. Java -> fully qualified name of a class/ interface
- Use Jarap tool after compilation of the program.

Defn of Data Encapsulation:-

The process of hiding the confidential data from external programmers is called "data encapsulation".

(Data encapsulation provides security to the confidential data.)

Programmatically, to implement data encapsulation we apply a keyword called private. Private features of a class will not participate in profiling process.

Defn of Data Abstraction:-

The process of retrieving/ extracting essential details without considering hidden details is called "data abstraction".

Q:- Some of the classes of Java does not contain constructor (True/ False)?

Ans:- False, becoz every class of Java contains constructor but the programmer of that class made the constructors defn as private.

① ~~Q1~~ Static Blocks in Java (77)

→ The purpose of static block is to initialize static

data members only once.

→ → Static block will execute only once when the class is loaded into main memory, before executing the main method.

→ → Syntax :-
 static
 {

 block of Stmt(s). initialization of static
 data members

}

→ When we write static block & main method in a single Java program then JVM will execute static block first & later main method once.

→ Writing static block is optional

→ When we write SB & constructors in a Java program, then JVM will execute SB only once & constructors will be executed each & every time.

→ In SB, we can access/initialize only static data members but not instance data members whereas both IDM & LDM are accessed in constructor.

→ In one Java class we can write any no. of static blocks but all those types of static blocks will be treated as single static block & gives the dp in that order in which we write.

- Whenever we initialize ⁽¹⁰⁰⁾ a sum in the class then by default that class will contain system defined static block.
- We can execute a Java program only by writing SB without writing main method upto JDK 1.6 version.
But it is not possible from JDK 1.7 Version.

* Write a Java program which illustrate the concept of static block in execution logic class.

// SBEX1.java

class SBEX1

{

static

{

SOP("I am from static block");

}

public static void main (String Fargs)

{

SOP("I am from main()");

}

}

Output :

I am from static block

I am from main()

- Q * Write a Java Program which illustrate the concept of
 Q only the SB in a class without main method. (Valid upto 1.6)
 Q & gives error in 1.7 onwards

1) SBEX2.java

```

class SBEX2
{
  static
  {
    System.out.println("I am from static block");
    System.exit(0);
  }
}
  
```

- * Write a Java program which illustrate the concept of SB
Present in ELC & in BLC by comparing with constructor & main method.

2) SBEX3.java

```

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

class SBEX3

(102)

{

static

{

SOP(" static block — SBEX3");

}

public static void main(String[] args)

{

SOP(" I am from main()");

Test t1 = new Test();

Test t2 = new Test();

}

}

Output :-

Static block — SBEX3

I am from main()

Static block — Test

Test → DC

Test → DC

* write a Java program which illustrate the concept of multiple

static blocks

1) SBEX6.java

class SBEX6

{

SBEX6()

{

System.out.println("

(03)

Static

{

SOP("Static block-1 - SBEX6");

}

public static void main(String args)

{

SOP("I am from main()");

SBEX6 s1 = new SBEX6();

SBEX6 s2 = new SBEX6();

}

Static

{

SOP("Static block-2 - SBEX6");

}

Static

{

SOP("Static block-3 - SBEX6");

}

} // SBEX6

Output:-

Static block-1 - SBEX6

Static block-2 - SBEX6

Static block-3 - SBEX6

I am from main()

SBEX6 - DC

SBEX6 - DC

* Write a Java program which illustrate the concept of initializing static data members in SB & IDM in constructor (Q)

1/SBEX8.java

```
class Student
{
    int sno;
    String name;
    static String crs;
    static
    {
        System.out.println("Student—static block");
        crs = "JAVA";
        System.out.println("Course for all = "+crs);
    }
}
```

```
Student (int sno, String sname)
{
    sno = sno;
    name = sname;
    System.out.println("Student Number = "+sno);
    System.out.println("Student Name= "+name);
}
```

} // Student

class SBEX8

{

```
public static void main (String []args)
```

{

Sop ("First student details");

Sop ("= = = = = = = = = = = = = = = =");

Student s1=new Student(1, "Sathya");

Sop ("= = = = = = = = = = = = = = = =");

Sop ("Second student details");

Sop ("= = = = = = = = = = = = = = = =");

Student s2=new Student(2, "RAJU");

Sop ("= = = = = = = = = = = = = = = =");

}

}

* Consider the following class definition

class Sathya

{

int a;

static int b=20;

}

The above class defn contains static data members

initialization. Due to this the defn of Sathya class
will contain default static block which is added
by Java compilation environment.

Instance Block :- (IB)

(106)

- The purpose of IB is exactly similar to DC of a particular class.
- IB will execute each & every time whenever an object is created before executing the constructor & after executing the SB.
- SB will execute only once when the class is loaded in main memory for initializing the SDM's whereas IB will be calling each & every time whenever an object is created before the constructor & it is used for initializing SDM's of a class.
- Syntax :-

{

block of Stmt(s) - initializing of SDM

}

- we can write any no. of IB's but all of the IB's will be treated as single IB & they will be executed in which order we write.

* Write a Java program which illustrate the concept of SB, IB & DC present in ELC.

// IBEx1.java

```
class IBEx1
```

{

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SOP("SB - IBEX1");

{

SOP("IB — IBEX1");

}

IBEX1();

{

SOP("IBEX1 — DC");

}

public static void main(String args)

{

SOP("I am from main()");

IBEX1 i01 = new IBEX1();

IBEX2 i02 = new IBEX2();

3

3

output :-

SB — IBEX1

~~IB~~ —

I am from main()

IB — IBEX1

IBEX1 — DC

IB — IBEX1

IBEX1 — DC

* Write a Java program which will initialize the DMs of
a particular class with DB & constructor in the PLC.

// IBEX2.java

class Test

{

 static

 SOP("Test-SB");

}

{

 SOP("Test-IB");

 a=10;

 { b=10;

 Test()

{

 SOP("Test-DC");

 a=100;

 b=200;

}

void disp()

{

 SOP("val of a =" + a);

 SOP("val of b =" + b);

}

} //Test - PLC

class IBEX2

{

 public static void main (String args)

(109)

```

1     sop( "I am from main ()");
2
3     Test t1 = new Test();
4     t1.displ();
5
6 }
```

Output :-

I am from main()

Test - SB

Test - IB

Test - DC

a = 100

b = 200

* write a Java program which illustrates multiple SB's, multiple IB's & multiple constructors in both BLC & ECL.

// IBEX3.java

class Sathya

{

{

sop("IB -1 → Sathya");

}

static

{

sop("SB → Sathya");

}

{

sop("IB -L → Sathya")

{
 SOP("IB-3 — Sathya");
 }

Sathya (int a)

{

SOP("Sathya - PC");

}

} II Sathya - BL

class IBEX3

{

static

{

SOP("IB - IBEX3");

}

{

SOP("IB - IBEX3");

}

IBEX3()

{

SOP("IBEX3 - DC");

}

public static void main(String args)

{

SOP("i am from math");

Sathya s1 = new Sathya(10);

int a = s1.sq();

int b = new Sathya(20);

IBEX3 i0 = new IBEX3();

(110)

3

3

outputs

SB - IBEX3

i am from main()

SB - Sathya

IB-1 - Sathya

IB-L - Sathya

IB-3 - Sathya

Sathya - DC

IB-1 - Sathya

IB-2 - Sathya

IB-3 - Sathya

Sathya - DC

~~IBEX3~~ - IB EX3

IBEX3 - DC

NOTE:-

A class of Java can contain 5 parts they are

a) Data members

b) methods

c) Constructors

d) static Block

e) Instance Block

2. Reading the data from the Keyboard :-

To read the data from the keyboard we use one pre-defined class called Scanner & it present in ~~java.util~~ package. ~~Scanner~~ & it ~~is~~ is available Jdk1.5 Version onwards.

Reading the data from the keyboard is nothing but creating an object of scanner class.

Profile of Java. util. Scanner :-

Constructor

① Scanner (InputStream)

IM

② Public xxx nextXXX()

③ Public String nextLine

→ Constructor ① is used for creating an object of scanner class by passing an object of ~~InputStream~~. An object of InputStream class call in created as a SDM in another pre-defined class called System.

Ex:- Scanner S = new Scanner (System.in)

Here S -

read actual
data from
Keyboard

Provider an
environment to
read the data
from Keyboard

- In method ② $\text{xxx}^{(112)}$ represents any fundamental data type
 - method ② is used for reading fundamental data from keyboard.
 - Method ③ is used for reading any type of data in the form of string type.
- * Write a Java program which will read 2 values from keyboard & find its sum.

/* DataRead.java

```
import java.util.Scanner;
class DataRead
{
    public static void main(String args)
    {
        Scanner s = new Scanner(System.in);
        System.out.println("Enter first value");
        int a = s.nextInt();
        System.out.println("Enter second value");
        int b = s.nextInt();
        int c = a+b;
        System.out.println("Val of a= "+a);
        System.out.println("Val of b= "+b);
        System.out.println("Sum= "+c);
    }
}
```

107 THIS :-

(113)

"THIS" is a keyword / implicit object / object created by JVM & supplied to each & every Java program for 2 purposes. They are

1. It always points to current class object
2. Whenever the formal parameters & data members of the class are same then JVM get ambiguity problems. (There is no clarity b/w multiple duplicate things). Inorder to differentiate b/w data members of the class & formal parameters, the data members of the class must be preceded by "THIS" keyword

SYNTAX

this. current class data member name

EX:-

* Write a Java program which illustrate the concept of "This" Keyword.

// ThisDemo.java

class Test

{

 int a,b;

 Test(int a, int b)

{

 this.a=a; // here we are assigning formal parameter value to data members of class

0 ~~this.a = this.a+2;~~ } // Here we are incrementing the values of
1 ~~this.b = this.b+2;~~ } class members of the class

2 ~~a = a+1;~~ } // Here we are incrementing the values of formal
3 ~~b = b+1;~~ } Parameters

4 Sop("val of a in constructor (FP) = " + a); } // Here a,b refers to
5 Sop("val of b in constructor (FP) = " + b); } formal parameters

6 }

7 void disp()

8 {

9 Sop("val of a = " + this.a); } // Here writing "this" keyword

10 Sop("val of b = " + this.b); } is optional

11 }

12 } // Test - ELC

13 class ThisDemo

14 {

15 Public static void main (String args)

16 {

17 ~~This t1,t2~~

18 Test t1 = new Test(10,20);

19 t1.disp();

20 Test t2 = new Test(100,200);

21 t2.disp();

22 } // main

23 } // ThisDemo - ELC

Output:

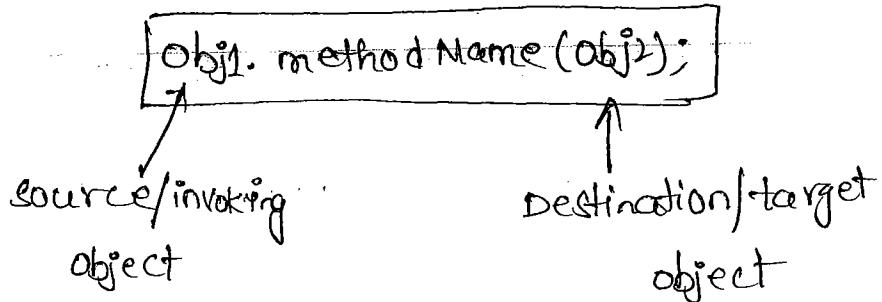
24 val of a in constructor (FP) = 11
25 val of b in " (FP) = 21

26 Val of a = 12

27 Val of b = 22

28 val of a in constructor (FP) = 101
29 val of b in " (FP) = 201
30 val of a = 102
31 val of b = 202

Let us consider the following statement



Whenever the stmt is executed method defn receives source object values in the form of "this" & destination object values are available in the form of formal object. Programmatically, source object values can be referred as

this. Data member of source object & destination object

values are referred as formal object. Data member of destination object

* Write a Java program which illustrate the concept of printing multiple object values with single method.

1/ThisDemo1.java

class Test

{

 int a,b;

 Test (int a,int b)

{

 this.a=a;

 this.b=b;

}

void disp(Test x) || ⁽¹¹⁶⁾ x is called formal object

{

System.out.println("val of a of t1 = " + this.a);

System.out.println("val of b of t1 = " + this.b);

System.out.println("val of a of t2 = " + x.a);

System.out.println("val of b of t2 = " + x.b);

}

} // Test - BLC

class ThisDemo1

{

 public static void main (String args)

{

Test t1 = new Test(10,20);

Test t2 = new Test(100,200);

 t1.disp(t2);

 ↑

 source
 object

 ↳ destination

 object

} // main

} // BLC

* write a Java program which will add the content
of 2 objects where each object contains 2 integer values

// Objum1.java

import java.util.Scanner;

class Test

{

 int a,b;

 Test()

{

$a = b = 0;$

(17)

}

Test($\text{int } a$, $\text{int } b$)

{

$\text{this.} a = a;$

$\text{this.} b = b;$

}

Test sum(Test x)

{

Test t44 = new Test();

t44.a = this.a + x.a;

t44.b = this.b + x.b;

return t44;

}

void disp()

{

sop("val of a = " + a);

sop("val of b = " + b);

}

} // Test - BLC

class obj{sum}

{

public static void main(String[] args)

// void sum(Test x, Test y)

{

// this.a = x1.a + x2.a;

// this.b = x1.b + x2.b;

}

Scanner s = new Scanner(System.in);

sop("Enter first value for t1");

int x1 = s.nextInt();

sop("Enter second value for t1");

int x2 = s.nextInt();

sop("Enter first value for t2");

int x3 = s.nextInt();

sop("Enter second value for t2");

int x4 = s.nextInt();

Test t1 = new Test(x1, x2);

Test t2 = new Test(x3, x4);

Test t3 = new Test();

// t3 = t1 + t2;

t3 = t1.sum(t2); // Sol - 1 (OR) // t3.sum(t1, t2); // Sol - 2

sop("T1 Value");

sop("=====");

t1.disp();

sop("=====");

sop("T2 Values");

sop("=====");

t2.disp();

sop("=====");

sop("T3 Values");

sop("=====");

t3.disp();

sop("=====");

} // main

} // Else

(19)

NOTE :- Java programming never supports operator overloading but the aim of operator overloading is achieved in Java programming with the simple concept of methods.

NOTE :- Any type of operator can be applicable by default on fundamental data types & their values but not applicable by default on derived data types (arrays) & user defined data types.

Consider the following statement

$t_3 = t_1 / t_2$ - Error

Bcz operator / will not function b/w t_1 & t_2

To address the above issue we've 2 solutions

Sol: 1 $t_3 = t_1.div(t_2);$

Sol: 2 $t_3 = t_1.div(t_2);$

* Factory Method :-

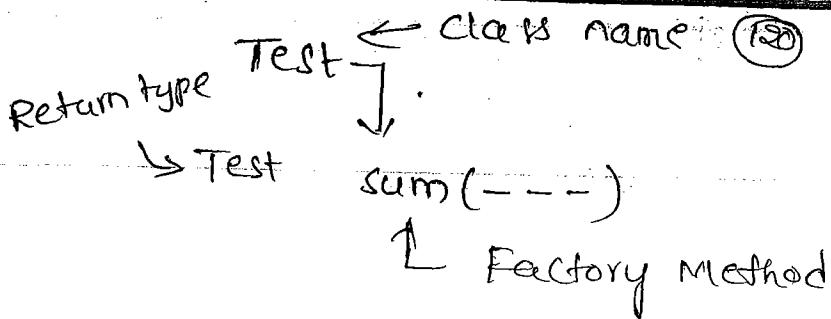
A method is said to be a factory method if & only if whose return type is similar to the class name in which class it presents.

The purpose of factory method is to create an object without using new operator.

We've 2 types of factory methods. They are

1. Instance Factory method

2. Static Factory method



* write a Java program which will multiply 3 objects
contents where each object contains 3 values.

$t_4 = t_1 * t_2 * t_3$ - Invalid

Sol-1

$t_4 = \text{MUL}(t_1, t_2, t_3)$

Sol-2

$t_4 = t_1 \cdot \text{MUL}(t_2, t_3)$

11 ObjMul.java

class Test

{

 int a,b,c;

 Test (int a, int b, int c)

{

 this.a = a;

 this.b = b;

 }

 this.c = c;

 Test()

{

 a=b=c=0;

}

Test mul (Test x, Test y)

{

```

Test tss = new Test();
tss.a = this.a * x.a + y.a;
tss.b = this.b * x.b + y.b;

```

void disp()

(12)

{

SOP("Val of a = " + a);

SOP("Val of b = " + b);

SOP("Val of c = " + c);

}

3.1) Test - BLC

class objMul

{

public static void main(String args)

{

Scanner s = new Scanner(System.in);

SOP("Enter first value for t1");

int x1 = s.nextInt();

SOP("Enter second value for t1");

int x2 = s.nextInt();

SOP("Enter first value for t2");

int x3 = s.nextInt();

SOP("Enter second value for t2");

int x4 = s.nextInt();

SOP("Enter first value for t3");

int x5 = s.nextInt();

SOP("Enter second value for t3");

int x6 = s.nextInt();

Test $t_1 = \text{new Test}(x_1, x_2)$; (182)

Test $t_2 = \text{new Test}(x_3, x_4)$;

Test $t_3 = \text{new Test}(x_5, x_6)$;

// $t_4 = t_1 * t_2 * t_3$;

$t_4 = t_1.\text{Mul}(t_2 * t_3); \leftarrow$ without using new operator we

can create an object.

$\text{SopC}("T_1 \text{ values}")$;

$\text{SopC}("= = = = = =")$;

$t_1.\text{dispC}()$;

$\text{SopC}("= = = = = =")$;

$\text{SopC}("T_2 \text{ values}")$;

$\text{SopC}("= = = = = =")$;

$t_2.\text{dispC}()$;

$\text{SopC}("= = = = = =")$;

$\text{SopC}("T_3 \text{ values}")$;

$\text{SopC}("= = = = = =")$;

$t_3.\text{dispC}()$;

$\text{SopC}("= = = = = =")$;

$\text{SopC}("T_4 \text{ values}")$;

$\text{SopC}("= = = = = =")$;

$t_4.\text{dispC}()$;

$\text{SopC}("= = = = = =")$;

3

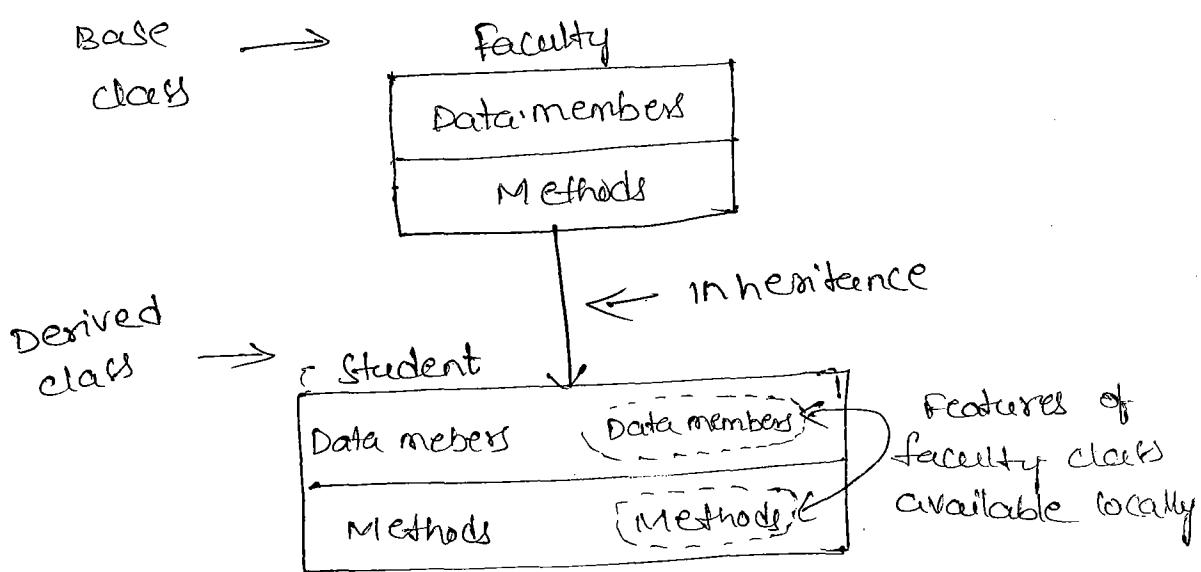
3

* Inheritance :-

The importance of inheritance in SW development is to build Scalable apps (high performance + consistent results) Effective memory management.

- Def :- The process of obtaining datamembers & methods (features) of one class into another class is called "Inheritance".
- The class which is giving data members & methods to another class is called base/ parent/ super class.
 - The class which is getting data members & methods from another class is called derived/ sub/ child class.
 - The inheritance concept is also known as re-usability/ sub classing/ derivation/ extendable classes.

Consider the following diagram.



In general, all the features of base class available logically in the context of derived class.

Inheritance concept always follows logical memory management.
i.e. more class available

- 0
- 1 In the derived class ⁽¹²⁾ class without taking any physical memory space. In otherwords, logical memory management keeps "feeling that base class features are existing without taking any memory space".

*Advantages/ Benefits of Inheritance/ Reusability :-

If we develop any Java appli with the concept of inheritance then such applis will get following advantages.

1. Application development time is less
2. Application memory space is less
3. Application execution time is less
4. Application performance is enhanced (improved)
5. Redundancy of code is minimized
(repeat)
6. We are able to get the slogan of Java i.e. WORA.

*Inheritance types/ Reusable techniques:-

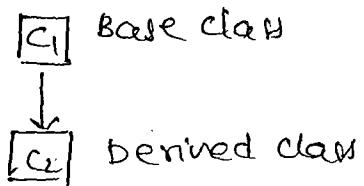
The patterns / models which makes us to understand how to inherit the features of base class into derived class. we've 5 inheritance types. They are

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

* Single Inheritance :- (125)

Def :- In this inheritance there exist single base class & single derived class.

Diagram :-

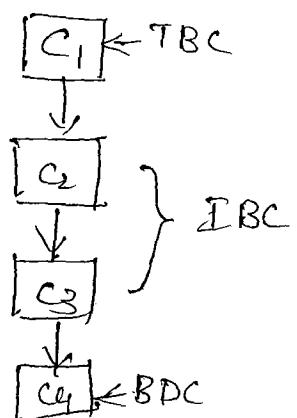


Inheritance Path :- $C_1 \rightarrow C_2$

* Multi-level Inheritance :-

Def :- In this inheritance there exist single base class, multiple intermediate base classes & single derived class.

Diagram :-



Inheritance Path :- $C_1 \rightarrow C_2 \rightarrow C_3 \rightarrow C_4$

Def of IBC :- An IBC in one context it acts as BC & in another context same class acts as DC

* Hierarchical Inheritance :-

Def :- In this inheritance there exist single base class & multiple derived classes.

Diagram :-

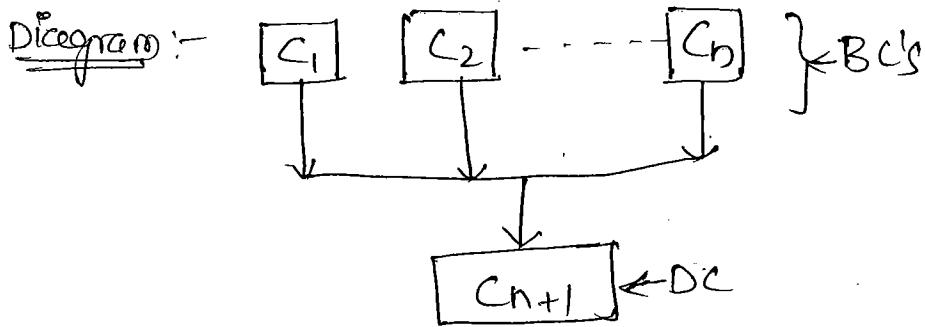


Inheritance Path :- $c_1 \rightarrow c_2, c_1 \rightarrow c_3 \dots c_1 \rightarrow c_n$

single, multilevel & hierarchical inheritances are supported by In Java. By the concepts of classes & interfaces.

* Multiple Inheritance :-

Def :- In this inheritance there exist multiple base classes & single derived class.



Inheritance Path :- $c_1 \rightarrow c_{n+1}, c_2 \rightarrow c_{n+1} \dots c_n \rightarrow c_{n+1}$

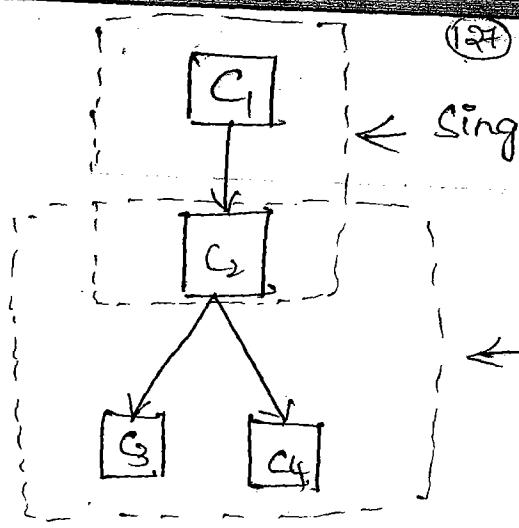
multiple inheritance is not supported in Java by

the concept of classes becoz of ambiguity problems.
But, this inheritance type is supported by the concept of interfaces.

* Hybrid Inheritance :-

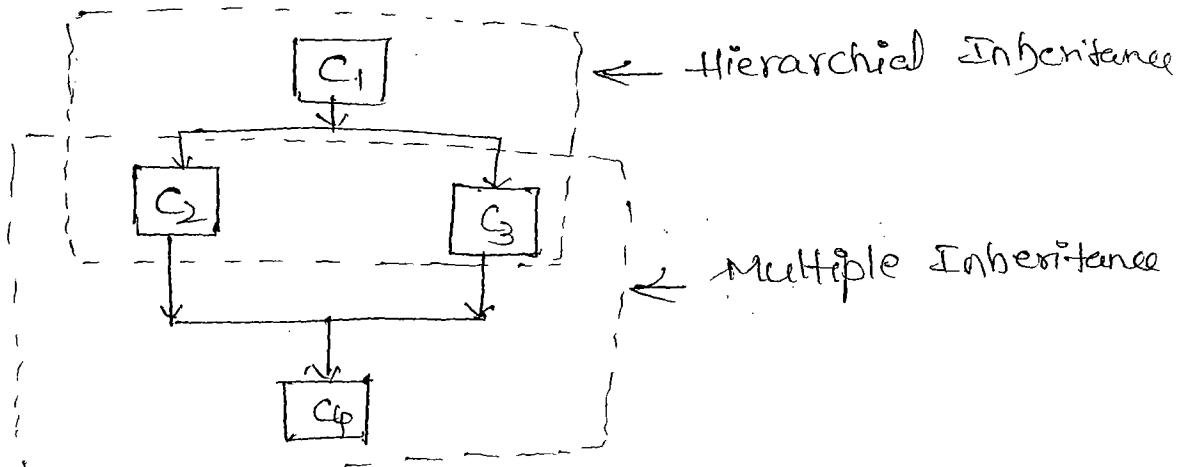
Hybrid Inheritance = combination of any available inheritance types

In the combination, if one of the combination is multiple inheritance then the entire combination (hybrid Inheritance) is not supported by classes but it can be supported by interfaces.



Hierarchical Inheritance

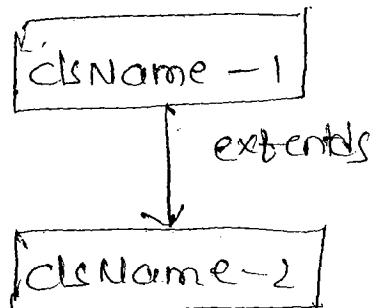
Valid by classes & interfaces



Invalid by classes & Valid by interfaces

Inheriting the features of base class into derived class:-

To inherit the features of BC into DC we use
the following SYNTAX.



SYNTAX :-

class <clsnName-2> extends <clsnName-1>
{ ... }

- Q In the above SYNTAX (P8)
- 1) <clsnName-1> & <clsnName-2> represents name of the base & derived classes.
 - 2) Extends is a keyword which is used for inheriting the features of base class into derived class plus it provides richest functionality to derived class.
 - 3) In Java programming one DC can extends only one BC becoz Java programming never supports multiple inheritance ~~than~~ through the concept of class or but it can be supported through the concept of interfaces.
 - 4) Whenever we develop any inheritance based CPP, it is always recommended to the Java programmer to create an object of BDC becoz it contains the features of TBC (top most base class) & intermediate base class (IBC).
 - 5) Whenever we create an object of bottom most derived class (BDC), first we get the memory space for data members of TBC, second we get the memory space for data members of IBC & at last we get the memory space for data members of BDC. All the features of TBC & IBC available logically in $\xrightarrow{\text{BDC}}$ the context of (logical memory management).
 - 6) If we don't want to give the features of base class to the derived class then the defn of the base class must be made as final. Hence, final base classes never participates in inheritance & features of the class can be inherited into derived class.

But those values can not be modified. (129)

7. If we don't want to give some of the features of base class then such features of the base class must be made as private. Hence, private features of base class never participates in inheritance (or) never visible/ acceptable in the context of derived class. Java programming does not contain just private classes (Inner private classes can be permitted)

8. In Java programming, data members & methods of a^{base} class can be inherited into derived class but constructors, static blocks & instance blocks of base class will not be inherited into derived class.

9. Scope of base class object :-

→ An object of base class can access the features of same class but an object of base class can't access the special features which are present in the context of its derived class.

10. For each & every class in Java there exist an implicit pre-defined super class called `java.lang.Object` becoz it provides garbage collection facility (`finalize()`) for collecting un used memory space for improving the performance of Java based applic.

* Write a Java program which illustrate the concept of inheritance. (130)

//Inhprogl.java

```
class BC
{
    int a;
    void disp()
    {
        System.out.println("base—disp()");
```

```
}
```

```
} //BC
```

class DC extends BC

```
{
```

```
    int b;
```

```
    void show()
```

```
{
```

```
    System.out.println("derived — show()");
```

```
    a=10;
```

```
    b=20;
```

```
    System.out.println("val of a from BC"+a);
```

```
    System.out.println("val of b from DC"+b);
```

```
}
```

```
} //DC
```

class Inhprogl

```
{
```

```
    public static void main (String [] args)
    {
        System.out.println("W.r.t. DC");
        DC doi=new DC();
        doi.disp();
```

Sop("w.r.t BC");

(18)

BC bo1=new BC();

bo1.dispc();

// bo1.show(); Invalid, becz show() does not exist in BC

}

}

NOTE:- If any class of Java contains private features (Data members & methods) then those features can be accessible in the context of same class with the same class object but not accessible in the context of some other class.

* Develop the Java program for the following problem statement.

1. There exist a university which contains university name, location & course. Use the appropriate methods for reading & displaying university details.

2. There exist a college which contains college Name, location & students details like no. name & doing which course. Use appropriate methods for getting & displaying clg & student details along with university details.

// Inhprob2.java

import java.util.Scanner;

class Univ

{

String uname;
int . . . incrs;

```
0     Scanner s = new Scanner(system, In); 132
1     void getUnivDetails()
2     {
3         sop("Enter Univ Name");
4         Uname = s.nextLine();
5         sop("Enter Univ Loc");
6         loc = s.nextLine();
7         sop("Enter Univ course");
8         Crs = s.nextLine();
9     }
```

```
void dispUnivDetails()
{
    sop("= = = = = = = = = = = =");
    sop("Univ Details");
    sop("= = = = = = = = = = = =");
    sop("Uname" + " " + Crs + " " + loc);
    sop("= = = = = = = = = = = =");
}
```

? // Univ - BC

class college extends Univ

```
{  
    String cname;  
    String cloc;  
    int stno;  
    String sname;
```

void getCollegeDetails()

(13)

{

Sop("Enter UR college Name");

cname = s.nextLine();

Sop("Enter UR college Loc");

cloc = s.nextLine();

Sop("Enter UR Name");

sname = s.nextLine();

Sop("Enter UR Number");

stno = Integer.parseInt(s.nextLine());

getUnivDetails(t);

}

void dispCollegeDetails()

{

dispUnivDetails();

Sop("= = = = = = = = = = ");

Sop("college Details");

Sop("= = = = = = = = = = ");

Sop("UR Name=" + sname + "UR Number=" + stno);

Sop("UR college Name=" + cname + "UR Loc=" + cloc);

Sop("= = = = = = = = = = ");

}

} // college - DC

class Inhprog2

public static void main(String[] args)

{

college co = new college();

co.getCollegeDetails();

co.dispCollegeDetails();

}

}

* Develop a Java program for the following problem Stmt

Let us assume there exist a company & it contains Company Name, location & type of operations & use the appropriate methods for getting & displaying Company details.

Let us assume there exist a permanent employee which contains employ no, employ name, basic salary & designation. Company gives DA as 40% of basic salary, TA as 20% of basic salary CCA = 500 & deductions like EPF as 5% of basic salary, LIC as 5% of basic salary. Calculate gross salary of employee [Gross Salary = (basic salary + DA + TA + CCA) - (EPF + LIC)]

Let us assume there exist adhoc employee & it contains employ no, name, no. of days working & ^{wage} rate per day. Calculate the total salary of Adhoc employee

[Total salary = No of working days * rate per day]

Generate the pay slips of permanent employee & adhoc employee with employee details along with company details.

* Types of relationships in Java (B5)

The purpose of relationships in Java is that how to use the features of one class into another class.

In Java programming we've 3 types of relationships. They are

1. IS-A Relationship
2. Has-A Relationship
3. uses-A Relationship

IS-A Relationship :-

In this relationship one class is obtaining the features of another class by using inheritance concept with extends keyword.

Keyword.

EXT
class C₁

{
=

}

class C₂ extends C₁

{
=

}=

Here the relationship always between C₁ & C₂ classes is "IS-A".

IS-A relationship always follows "logical memory management". The limitation of "IS-A" relationship is that unable to eliminate the ambiguity problems which are occurring in multiple inheritance. To avoid the above problem we use the concept of "Has-A" relationship.

*has-A Relationship:-

(136)

- An object of one class is created as a data member
- in the context of another class.

→ Ext class c₁,

{
=

}

class c₂ ← has-A

{

c₁, o₁ = new c₁();

=

}

Here the relationship btw c₁ & c₂ is "has-A".

"Has-A" relationship always follows physical memory management

class c₁

{

int a=10;

}

class c₂

{

int a=20;

}

class c₃ extends c₁, c₂ invalid (dl) error

{
=

}

To overcome the above problem we apply "has-A" relationship
and we can rewrite the above code as follows.

Ex:- class C₁,

{

int a=10;

}

class C₂

{

int a=20;

}

class C₃

{

int e;

C₁ o₁=new C₁();

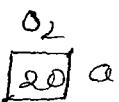
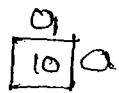
C₂ o₂=new C₂();

==

c=o₁.a+o₂.a;

==

}



*Uses-A relationship:-

A method of one class is using an object of another class

class

Ex:- class C₁

{

==

}

class C₂ ← uses-A

{

void disp()

{ C₁ o₁=new C₁();

==

}

... i.e. it is used

Note:1

The default relationship in Java is "Is-A" because for each & every class in Java there exist an implicit predefined Super class called `java.lang.Object`.

Note:2

The universal example for "has-A" relationship is `System.out` (here out is an object of `PrintStream`) & it is created as a static data member in another class called `System`. The relationship b/w `System` & `PrintStream` class is known as "has-A" relationship.

Note:3

The universal example for "uses-A" relationship is that execution logic method of execution logic class is using an object of business logic class.

* Super Keyword:

Whenever we inherit the base class features into derived class, there is a possibility that base class features are similar to derived class features & JVM gets an ambiguity.

In order to overcome the ambiguity problems (d) to differentiate b/w base class features & derived class features. In the context of derived class the base class feature must be preceded by `super` keyword. otherwise such features will be treated as current class/derived-class features.

Syntax

`super. Base class Feature Name`

Super Keyword is playing an important role in 3 places

They are

1. At variable level
2. At method level
3. At constructor level

* Super at variable (Data member) level :-

Whenever we inherit the base class data members into derived class, there is a possibility that base class data members are similar to derived class data members & JVM gets an ambiguity.

In order to differentiate btw BC data members & DC data members in the context of DC the BC data members must be preceded by a "Super" keyword.

Syntax:- Super <Base class data member name>;

If we don't write Super keyword before the BC data member name then it is considered as current class data member & it is hidden in the context of DC.

Ex:- Write a Java program which illustrate the concept of Super Keyword

at variable level.

```
1 SDemo.java  
class BC  
{  
    int a;  
}  
  
class DC extends BC  
{  
    int a, c;  
    void set(int x, int y)  
    {  
        Super.a = x;  
        this.a = y;  
    }  
}
```

```
void add()  
{  
    c=Super.a+this.a;  
}  
  
void disp()  
{  
    SOP("Val of a (BC) = "+Super.a);  
    SOP("Val of a (DC) = "+this.a);  
    SOP("Sum = "+c);  
}  
  
class SDemo  
{  
    public static void main(String args)  
    {  
    }
```

```

    DC d01 = new DC();
    d01.set(Integer.parseInt(args[0]), Integer.parseInt(args[1]));
    d01.add();
    d01.disp();
}
}

```

(40)

Super at method level :-

Whenever we inherit base class methods into DC, there is a possibility that base class methods are similar to DC methods & JVM gets an ambiguity.

To differentiate b/w BC methods & DC methods, in the context of DC methods BC methods can be referred by using super keyword.

Syntax :- Super<base class method name>;

If we don't write super keyword before the base class method name then JVM will call the DC method infinitely & base class methods are hidden in the context of DC.

NOTE :- Any method called by itself infinitely then stack memory becomes full & such type of error is known as Stack Overflow Error.

* Write a Java program which illustrate the concept of Super keyword at method level.

// SDemo1.java

class BC

{

void disp()

{

System.out.println("Base class - disp()");

}

```

class DC extends BC
{
    void disp()
    {
        System.out.println("Derived class - disp()");
        super.disp(); // call super
        class disp() from the
        context of DC
    }
}

```

Class Sdemo

(141)

```
{  
    public static void main(String[] args)  
    {  
        DC doi = new DC();  
        doi.disp(); // will call derived class disp()  
    }  
}
```

Q:- What is the difference b/w 'this' & 'super' keyword?

A:- 'this' keyword always points to current class features
'super' keyword always points to super class features.

Super at method level:-

Whenever we inherit base class methods into DC, there is a possibility that base class methods are similar to DC methods & JVM gets an ambiguity.

To differentiate b/w BC methods & DC methods in the context of DC methods base class method can be referred by using 'super' keyword.

Syntax:- Super< baselassmethod.name>;

If we don't write 'super' keyword before the BC method name then JVM will call the DC method infinitely & BC methods are hidden in the context of DC.

Note:- Any method called by itself infinitely then stack memory becomes full & such type of error is known as StackOverflowError.

* Write a Java program which illustrate the concept of 'super' keyword at method level.

//Sdemo.java

class BC

{

void disp()

{

SOP("base class: disp()");
}
}

(42)

Class DC extends BC

```
{  
    void disp()  
    {  
        SOP("derived class: disp()");  
    }
```

Super.disp(); // Call super class disp() from the context of DC.

}

Class Sdemo

```
{  
    public static void main(String args[])
```

{

```
    DC dcl = new DC();  
    dcl.disp(); // will call DC disp()
```

}

}

Super at method overridden level:-

WRT method overriding is equal to method heading
is same plus method body is different.

To implement method overriding concept we need to use
inheritance concept.

Original methods always presents in BC's & overridden methods
always presents in DC's.

* Write a Java program which illustrate the concept of super

Keyword at method overridden level.

ISdemo.java

class BC

{

void op(int x, int y)

```
SOP("opc") : original : BC");
```

(43)

```
int z = x+y;
```

```
SOP("sum in BC = "+z);
```

}

}

```
class IBC extends BC
```

{

```
void op (int x, int y)
```

{

```
Super. op (x, y);
```

```
SOP("opc") : overridden : IBC");
```

```
int z = x-y;
```

```
SOP("sub in IBC = "+z);
```

}

}

```
class DC extends IBC
```

{

```
void op (int x1, int x2)
```

{

```
Super. op (x1, x2);
```

```
SOP("op() : overridden : DC");
```

```
int z = x1*x2;
```

```
SOP("mul in DC = "+z);
```

}

}

```
class Demo
```

{

```
public static void main (String [] args)
```

{

```
DC dcl = new DC();
```

```
dcl.op(10, 20);
```

(or)

```
new DC().op (Integer.parseInt  
(args[0]), Integer.parseInt(args[1]))
```

}

}

In the above program
new DC() is known as
nameless/anonymous class
object

Q: How do you call BC methods from the context of DC methods
where both the methods are same?

Ans:- Super<base class method name>

The above Stmt must be written in the context of DC.

Q: How do you call original method from the context of overridden methods?

Ans:- Super<original method name>

The above Stmt must be written in the context of overridden method of DC

Whenever we apply super keyword at variable & method level then it can be used b/w immediate BC & DC's but not b/w bottom most DC. Super keyword either at variable level or method level can be applied at any one level.

Super.super.methodname is not valid.

Super at constructor level:-

Whenever we develop any inheritance appi it is highly recommended to create an object of bottom most DC bcoz it obtains features from top most BC & intermediate BC.

When we create an object of bottom most DC, first we get the memory space for data members of top most BC, 2nd we get memory space for data members of intermediate BC & at last we get memory space for data members of bottom most DC

In whatever the order memory space is created in the same order data members will be initialized (otherwise we get compile time error) i.e., first top most BC data members will be initialized second intermediate BC data members will be initialized & at last bottom most DC data members will be initialized. Note initializing the data members requires constructors concept.

Hence, in any inheritance appi development, constructors are calling from bottom to top & execution is from top to bottom

In order to establish communication btw BC constructors & DC constructors we have two implicit functions. They are

1. `super()`
2. `super(...)`

`super()` :- It is used for calling Super class default constructor from DC constructors.

`super(...)` :- It is used for calling super class parameterized constructor from DC constructors.

Rules :-

Whenever we use either `super()` (or) `super(...)` in the DC constructors, they must be used as a first executable stmt. Otherwise we get Compile time error (becoz before executing DC constructors first we must execute Super class constructors)

Possibilities of using `super()` & `super(...)` :-

The following diagram gives possibilities of using `super()` & `super(...)`

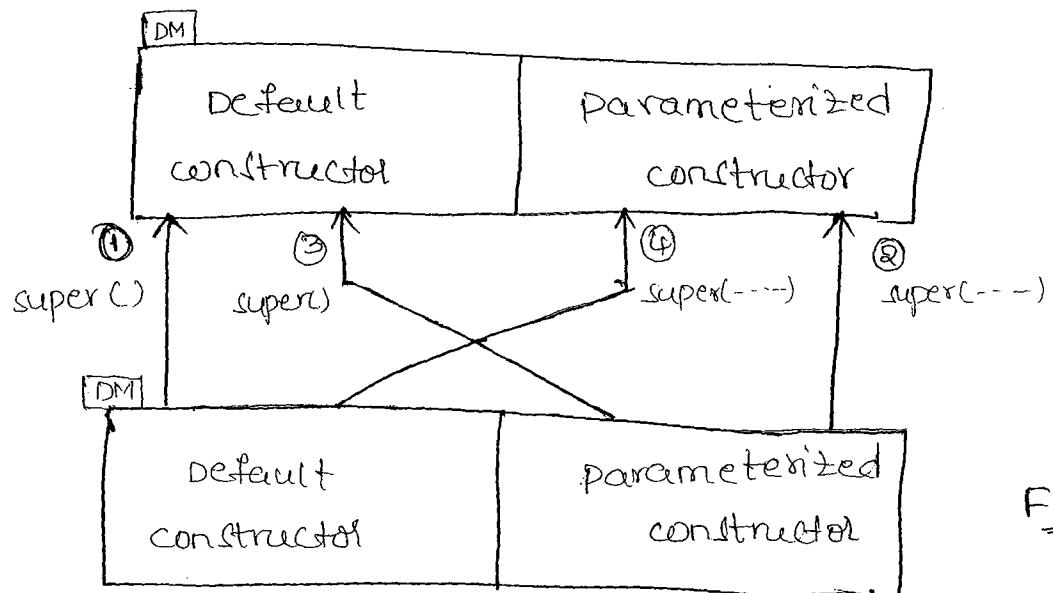


Fig :- 1

Rules ① & ②:-

(148)

Whenever we want to call base class default constructor from the context of DC constructor in the context of DC constructor we use Super().

Using Super() in the context of DC constructor is optional bcoz BC will contain single form of default constructor.

Rules ③ & ④:-

Whenever we want to call BC Parameter as a constructor from the context of DC constructor in the context of DC constructor we must use Super(---).

Using Super(---) in the context of DC constructor is mandatory bcoz a BC may contain multiple parameterized constructor.

* Write a Java program which will illustrate Rule ① of fig ①.

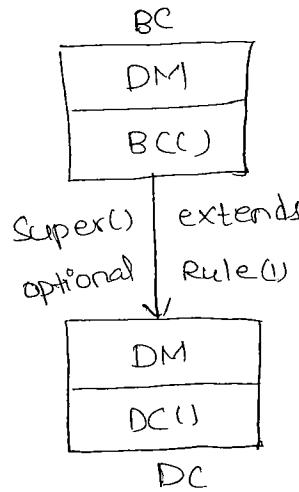
```
class BC
{
    int a;
    BC()
    {
        // ①
    }
    {
        System.out.println("BC → Default constructor");
        a=10;
        System.out.println("val of a from BC = "+a);
    }
}
```

```
class DC extends BC
```

```
{
    int b;
    DC()
    {
        // ②
    }
}
```

Super(); // optional - control goes to ②

System.out.println("DC → Default constructor");



b=20;

(147)

sop(" val of b from DC = " + b);

}

}

class sdemo

{

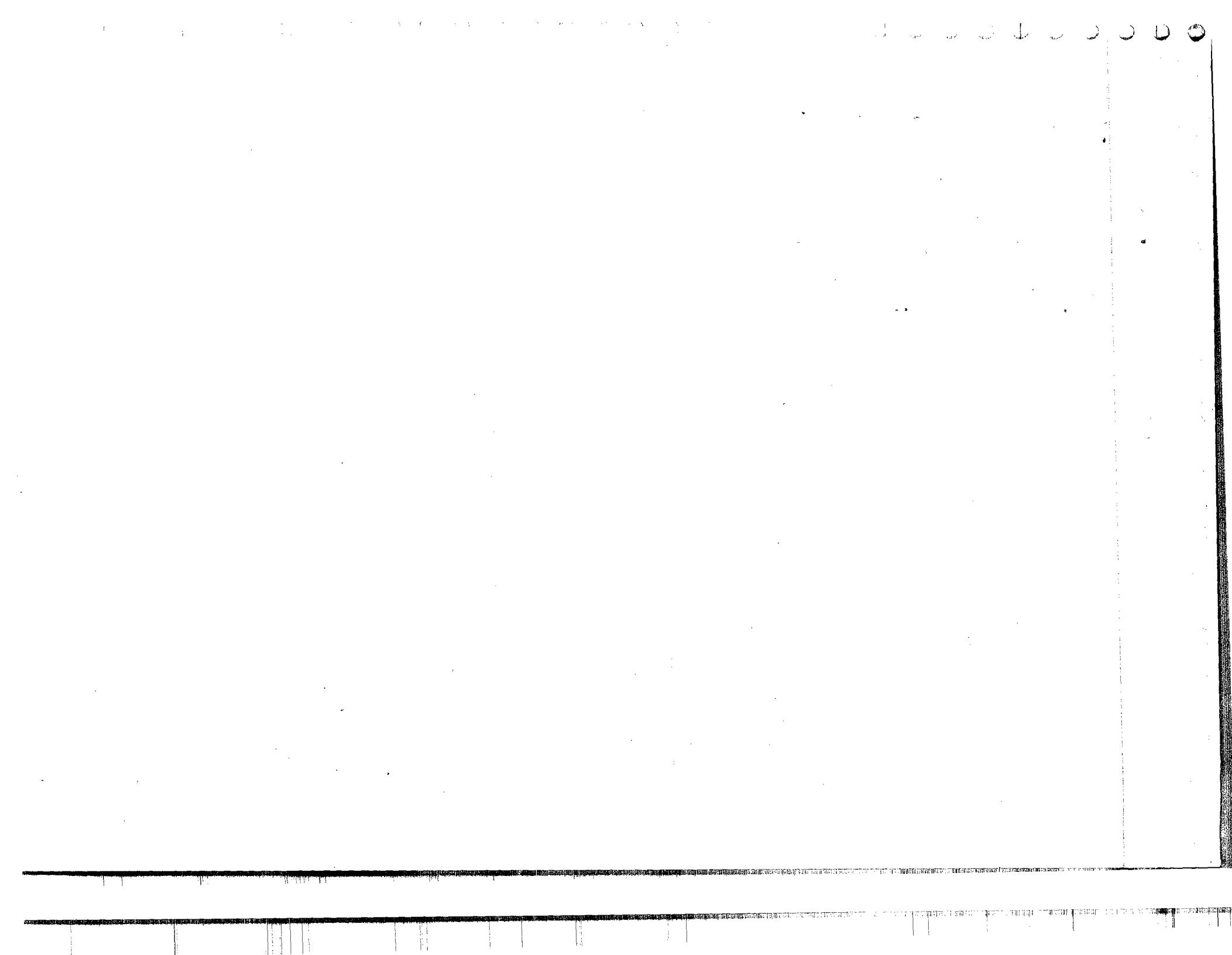
private static void main(String [] args)

{

new DC(); // control goes to ①

}

}



* write a Java program (Q) which illustrate rule-2 of fig (a)

HInhprog8.java

class BC

{

 int a;

 BC(int a) { } --- (2)

}

 System.out.println("Base --- PC");

 this.a = a;

 System.out.println("val of a from BC = " + this.a);

}

} // BC

class DC extends BC

{

 int b;

 DC(int a, int b) { } --- (1)

{

 super(a); // mandatory --- control goes to (2)

 System.out.println("derived --- PC");

 this.b = b;

 System.out.println("val of b from DC = " + this.b);

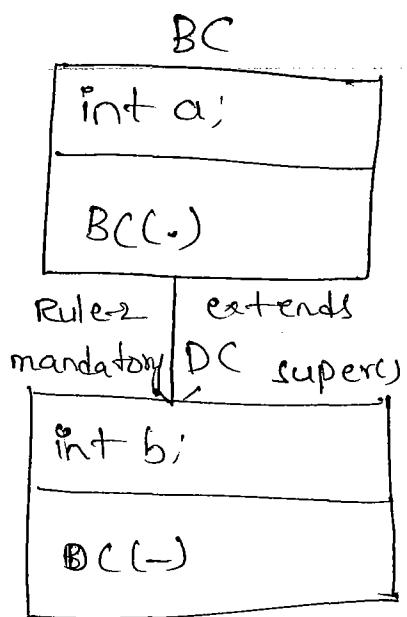
}

} // DC

class InhProg

{

 public static void main(String[] args)



21/7

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* write a Java program which illustrate rule(3)
of fig (1)

→ // Inbprog7.java

class BC

{

int a;

BC() // ----- (2)

{

System.out.println("Base --- BC");

a=100;

System.out.println("val of a from BC = " + a);

}

} // BC

class DC extends BC

{

int b;

DC(int b) // ----- (1)

{

super(); // optional --- control goes to (2)

System.out.println("derived --- DC");

this.b=b;

System.out.println("val of b from DC = " + this.b);

}

} // DC

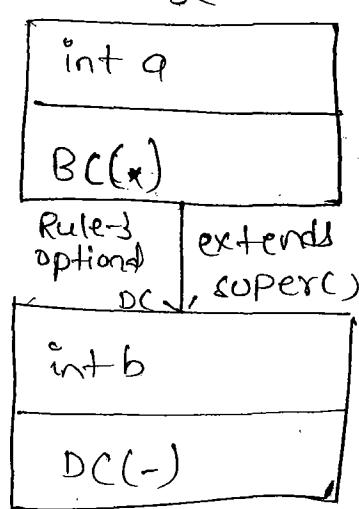
class Inbprog7

{

public static void main (String [] args)

{

DC doi = new DC(20); // control goes to (1)



* write a Java program which illustrate rule-4 of fsgo

Inhprog & Java

class BC

{

 int a;

 BC(int a) // --- (2)

{

 Sop("Base --- PC");

 this.a = a;

 Sop("val of a from BC = "+this.a);

}

} // BC

class DC

{

 int b;

 DC() // --- (1)

{

 super(); // mandatory ... control goes to (2)

 Sop("derived --- DC");

 b=2;

 Sop("val of b from DC = "+b);

}

} // DC

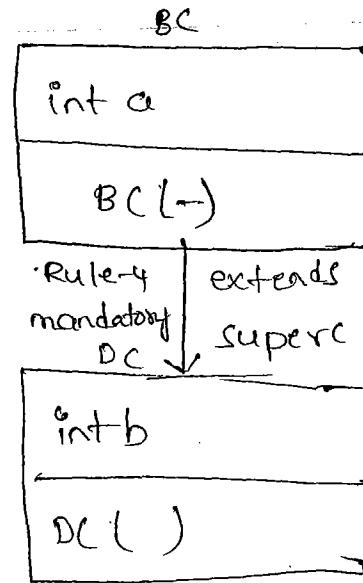
class Inhprog 8

{

 public static void main(String args)

{

 DC dc1 = new DC();



In all the above examples constructors are calling bottom to top [increasing order] \rightarrow Q1 & exceeding from top to bottom [decreasing order (2) \rightarrow (1)].

*this() & this(...):

this() (or) this(...) are the two implicit methods created by JVM & supplied to each & every Java program for the purpose of establishing the connection b/w current class constructors.

1. this(): It is used for calling current class default constructor from current class parameterized constructor.

2. this(...): It is used for calling current class parameterized constructor from current class other category constructors.

*Rules:

① When we use this() (or) this(...) in the current class constructors, they must be used as first executable statement. Otherwise we get compile time error.

② When we use this() or this(...) in the current class constructors, it is recommended to form path but not recommended to form cycles. Bcoz cycles always generates ~~an~~ irreversible constructor invocation problem.

* Write a Java program which illustrate the functionality of this() & this(...).

1) ThisDemo2.java

class Test

{

 int a,b;

 Test() { // ---(2)

{

 this(100); // control goes to (3)

 System.out.println("test --de");

 a=1;

 b=2;

 System.out.println("val of a = "+a);

 System.out.println("val of b = "+b);

}

 Test(int x) { // -----(3)

{

 System.out.println("test --- DPC");

 a=b=x;

 System.out.println("val of a = "+a);

 System.out.println("val of b = "+b);

}

 Test(int a,int b) { // -----(1)

{

 this(); // control goes to (2)

 System.out.println("test -- DPC");

 this.a=a;

 this.b=b;

(SOPC" val of a = " + this.a);
 SOPC" val of b = " + this.b);

{

-- } // Test

class ThisDemo2

{

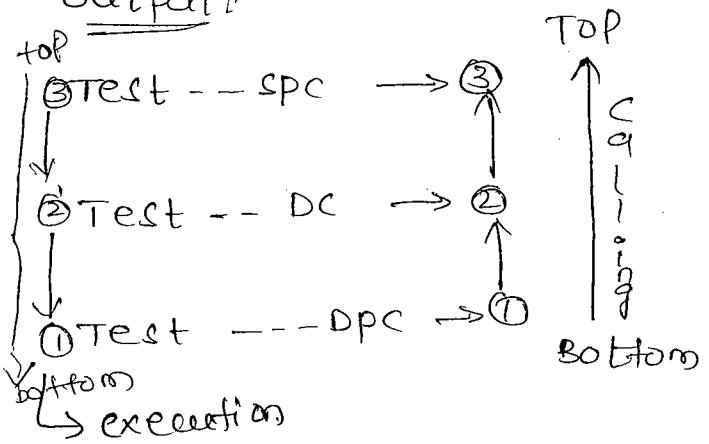
public static void main (String [] args)

{

Test t₁ = new Test(10, 20); // control goes to (1)

}

}

Output

→ Hence even in the current class constructors are calling
com., const current class constructors are calling
from bottom to top & executing from top to bottom

Q: What is the difference b/w this & super keyword?
 Ans: this keyword is always used to refer current
class object & differentiating b/w data members &
formal parameters. whereas super keyword is always
used in pointing base class features & differentiated

BC features & DC features ⁽¹⁵⁴⁾ are same

Q2: What is the difference b/w this(), this(...),
super(), super(...)?

Ans:- this() & this(...) are used for establishing com. b/w current class constructors whereas super() & super(...) is used for establishing com. b/w BC & DC constructors.

NOTE:- whenever we come across multiple this() or this(...) then we get compile time error. according to rule of this & with my intelligence I can address multiple this functions issue.

NOTE:- one can also solve multiple this functions & super functions & multiple super functions but we can't solve super & this functions bcoz super classes constructors can't call derived class constructors.

this - this — allow

this - super — allow

super - super — allow

super - this — Not allow.

22/7 Polymorphism :-

Polymorphism is one of the distinct principle of OOPS & whose basic aim is to build scalable apps (high performance + less memory consumption)

Def :-

The process of representing "one form in multiple forms" is called Polymorphism.

→ In the defn of Polymorphism, one form represents original method & always resides in BC. multiple forms represents over ridden methods & always resides in DC's.

→ Polymorphism is one of the principle but not a programming concept. All the OOPL's will implement Polymorphism principle by various programming concepts.

→ In Java programming, Polymorphism principle implemented by using 2 approaches. They are

- Method overriding
- Method overloading

→ The polymorphism principle is having 2 sub principles. They are

(a) static / compile time polymorphism } Types of polymorphism
 (b) dynamic / run time polymorphism }

→ Java programming follows only dynamic polymorphism but not static polymorphism due to its limitations.

→ In real world apps (156) Polymorphism principle is always used for developing business logic

consider the following diagram

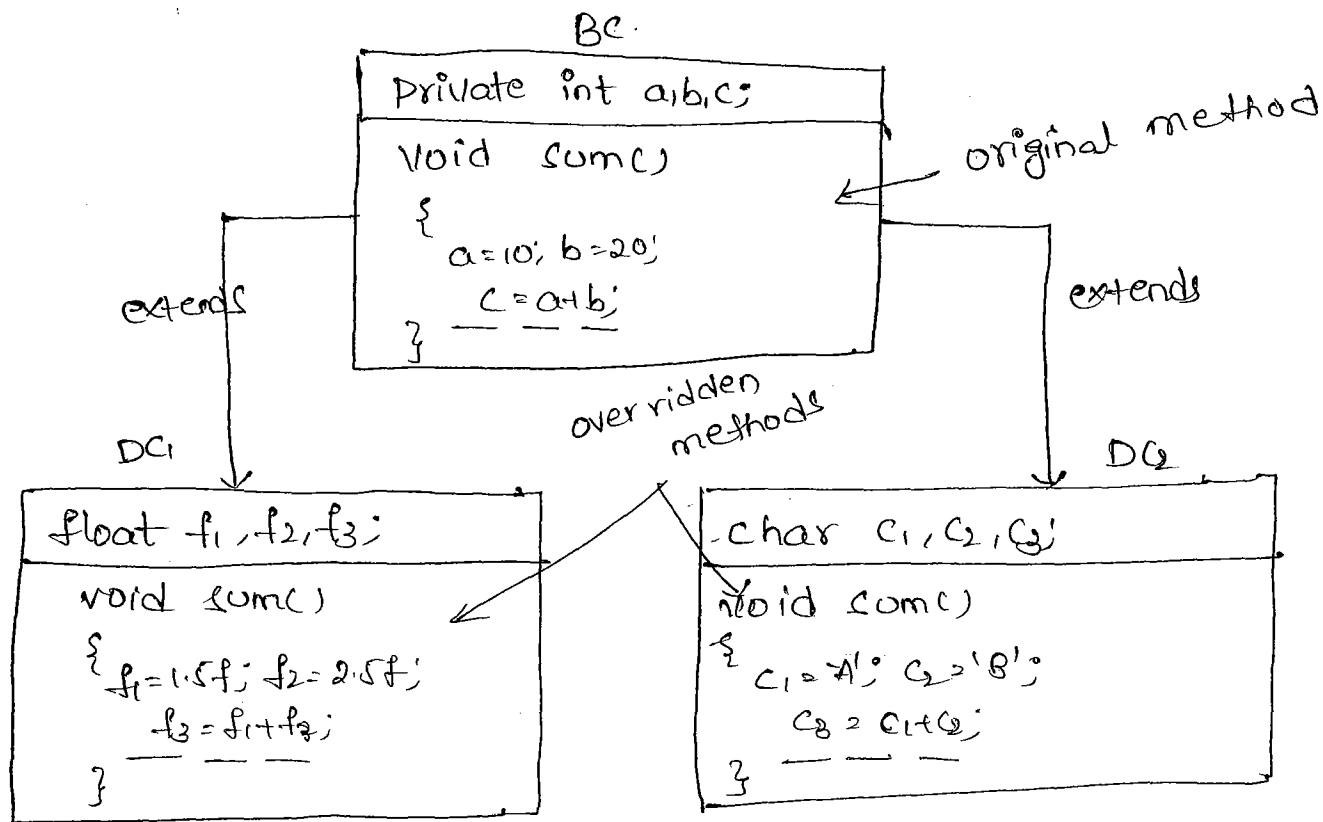


Fig (1)

In the above diagram the sum method is available in one form originally & it is further implemented in multiple forms by overriding original method & hence sum method is called polymorphic method.

The classes DC₁ & DC₂ are inheriting the features from BC class & hence the business logic is developed by following polymorphism principle along with method overriding in the form of dependent business logic classes (BLC).

Dynamic Binding :-

(15)

Dynamic binding is one of the distinct principle in OOPS which helps us to develop effective execution logic.

- Dynamic binding always says "don't create the object of DC's but create the object of BC"
- we always use dynamic binding for executing polymorphic apps.
- The advantages of Polymorphism along with method overriding & dynamic binding principle are
 - (a) application takes less memory space.
 - (b) application takes less execution time.
 - (c) application performance is enhance (improve)
- Def of Dynamic binding :-

The process of binding appropriate versions (overridden methods) of DC's which are inherited from BC with BC object is called dynamic binding.

- When we use dynamic binding principle at the time of using polymorphic apps then JVM will consider internally the following 2 points.
 - (a) What type of object?
 - (b) What type reference object contains?

In other words, when we create an object indirectly (following dynamic binding principle) then JVM will consider the above 2 points.

NOTE:- To create an object indirectly by using dynamic binding principle, there must exist Super-Sub/Base-Derived relationship (is-a relationship) (15)

EX:- Parent p = new Child

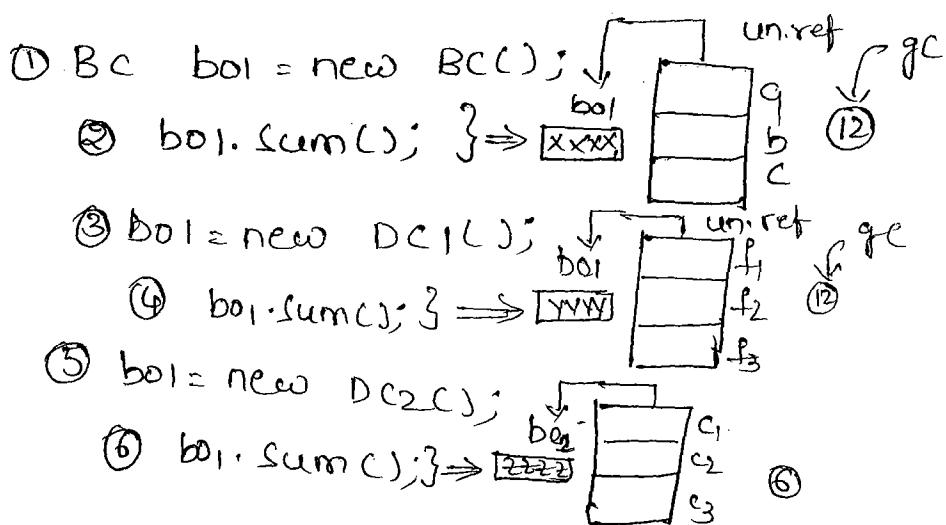
→ Here Parent is a super class & child is the sub class

→ Here p is an object of type Parent & an object p contains reference of child.

→ Type of object makes us to understand JVM will look for existence of method

→ Type of reference makes us to understand JVM will execute the method.

Ex Let us consider the following set of executable statements (EL) which are used for executing the program represented in fig(a) by using dynamic binding principle.



In the above statements

→ In line numbers ①③⑤ the object `b01` contains a reference to an polymorphic object.

- The method sum is actually available in one form & it is implemented in multiple forms & hence sum () is called polymorphic method.
- In line numbers ④, ⑤, ⑥ the stmt bo1.sum() is actually one stmt but it gives int sum, float sum & char sum & hence the stmt is called Polymorphic Stmt.

In real world, we can develop any appii by using 3 cases.

case:-1 Develop the Business logic in the form of independent classes & we develop the execution logic by direct object creation (plain old Execution logic)

case:-2 We develop the BL in the form of dependent classes & we develop by following polymorphism along with method overriding & we develop the EL by using direct object creation

The above 2 cases gives the following limitations

- (a) Appii takes more memory space
- (b) Appii takes more execution time.
- (c) Appii gives performance is degraded.

Hence case 1 & case 2 are not recommended.

case:-3 We develop the BL in the form of dependent classes by following polymorphism along with method overriding & we develop the EL by using dynamic binding principle (Indirect object creation)

cases will give the following advantages (160)

(a) App II takes less memory space

(b) App II Execution time is less

(c) App II performance is enhance

Hence, industry recommends to follow cases.

Whatever the cases OOP's app II follows polymorphism dynamic binding principles those app II will get the benifites of polymorphism & dynamic binding.

24/7

Q:- Define static Polymorphism & dynamic Polymorphism?

Ans:- In static polymorphism the overloaded methods binds with an object at compile time.

The limitation static polymorphism is effect poor utilization of the resources (main memory)

In dynamic polymorphism the overloaded methods binds with an object at run time.

The advantage of dynamic polymorphism is that effective utilization of the resources.

Java programming follows only dynamic polymorphism but not static polymorphism due to its limitation.

Even though, C++ programming follows both static & dynamic polymorphism, the real time C++ programmes will follow only dynamic polymorphism.

(16)

- **Sharp NOTE 1:-** When we implement polymorphism with method overloading concept then JVM will always consider signature of the over loaded methods.
- **Sharp NOTE 2:-** When we implement polymorphism concept with method overriding then JVM will always consider reference of derived classes (DC) present in the object of base class (BC).

Abstract classes in Java

WKT each & every Java program starts with a concept of class. Without classes concept we can't develop any purposeful app!!.

In Java programming we've 2 types of classes. They are

1. concrete classes
2. Abstract classes

Concrete class

- A concrete class contains fully defined methods.
- Defined methods of a class are also known as concrete implemented methods.
- once the class is concrete we can instantiate (creation) its object directly.

Ex & class Test

(162)

```
{  
    void show()  
{  
        cout<<"show";  
    }  
  
    void disp()  
{  
        cout<<"disp";  
    }  
}
```

Here Test is one of the concrete class & whose object can be created directly.

```
Test t;  
t.show();  
t.disp();
```

In real world apps concrete classes are always recommended to deal with specific requirements which are suitable for individual programmers. It is not recommended to use concrete classes to deal with common requirements which are suitable for all the programmers.

If we choose concrete classes to deal with common requirements then we get the following limitations.

1. App takes more memory space
2. App takes more execution time
- ...
... is deleted.

- To overcome these limitations to fulfil the common requirements of all the programmers. Industry is recommended to use the concept of abstract classes.
- We use always abstract classes to deal with common requirements. Programmatically, abstract classes contain common features which are suitable for all the programmers.

Defn of abstract class :-

→ An abstract class is a collection of defined methods and un defined methods.

undefined methods of a class are also known as abstract methods (or) un implemented methods

Defn of abstract method :-

→ In abstract method contains only method heading/prototype/declaration but not containing method body/definition.

To make un defined method as abstract method the declaration of the un defined method must be preceded by a keyword **abstract** otherwise we get compile time error.

Syntax for abstract method

abstract Ret-type methodName (^{list of formal parameters})
^{types if any}

Eg:- abstract void op(int, int); (164)
abstract void sum();
abstract void draw();

→ In Java every method of Java belongs to a class including abstract methods. If any class of Java contains any abstract methods then it is called abstract class. & whose defn must be made as abstract by using abstract keyword otherwise we get compile time error.

Syntax for abstract class

abstract class <classname>

{

 abstract Ret-type methodName(list of formal
 parameters types);

 }

Eg:- abstract class operations

{

 abstract void op(int, int);
 abstract void sum();
 abstract void draw();

 }

-
- → Here, operations is one of the abstract class & whose object can't be instantiated directly bcoz there is no use of calling abstract methods. But an object of operations class can be created indirectly wrt implementation class. (This class will provide defn for abstract methods of abstract class)

Eg:-

operations O₁ = new operations(); // Invalid

Hence, in general an object of abstract class can't be created directly but it can be created indirectly wrt implementation/ derived class.

* Write a Java program which will compute two integers
2 floats etc

// Abdemo1.java

import java.util.Scanner;
abstract class operations

{

Scanner s=new Scanner(System.in);

abstract void sum();

} // Operations

class Isum extends operations

{

int a,b,c;

void sum()

(166)

{

```
sop("Enter first int val");
a=Integer.parseInt(s.nextLine());
sop("Enter second int val");
b=Integer.parseInt(s.nextLine());
c=a+b;
sop("int sum=" + c);
```

}

} // Ifsum - impl class

class Ifsum extends operations

{

```
float a,b,c;
void sum() // overriding abstract method
```

{

```
sop("Enter first float val");
a=Float.parseFloat(s.nextLine());
sop("Enter second float val");
b=Float.parseFloat(s.nextLine());
c=a+b;
sop("float sum = " + c);
```

}

} // Ifsum - impl class

class Abdemo1

```
{ public static void main(String[] args)
```

{
 // Operations O1 = new operations(); invalid, operation is
 abstract

SOP("w.r.t. operations --- ISum --- Dynamic Binding");

operations O1 = new ISum();

O1.sum();

SOP("w.r.t. operation --- FSum --- Dynamic binding");

O1 = new FSUM();

O1.sum();

}

{
 * write a Java program which will calculate area
 of different shapes. like circle, rect & square.

// Abdemo2.java

import java.util.Scanner;

abstract class Shape

{

Scanner s = new Scanner(System.in)

abstract void area();

{
 // shape

class Circle extends Shape

{

float pi, r;

int a;

void area()

{

SOP("enter the value of radius");

(168)

```
r = float.parseFloat(s.nextLine());
a = PI * r * r;
System.out.println("Area of circle = " + a);
```

{

} || circle

class rect extends shape

{

```
int a, b, l; void area();
System.out.println("Enter first int Val");
l = Integer.parseInt(s.nextLine());
```

```
System.out.println("Enter second int Val");
```

```
b = Integer.parseInt(s.nextLine());
```

```
c = l * b;
```

```
System.out.println("Area of rect = " + c);
```

}

} || rect

class square extends shape

{

```
int a, d;
```

```
void area()
```

{

```
System.out.println("Enter the value");
```

```
a = Integer.parseInt(s.nextLine());
```

```
d = a * a;
```

```
System.out.println("Area of square = " + d);
```

?

Class Abdemo2

(169)

{

public static void main(String[] args)

{

System.out.println("w.r.t shape --- circle --- Dynamic binding");

Shape s1 = new Circle();

s1.area();

System.out.println("w.r.t shape --- rect --- Dynamic binding");

s1 = new Rect();

s1.area();

System.out.println("w.r.t shape --- square --- dynamic binding");

s1 = new Square();

s1.area();

}

}

* write a Java program which will calculate sweeping of
2 integers, 2 floats, 2 chars etc.

* write a Java program which will calculate perimeter
of different shapes like circle, rect, square etc

Points to be remembered :-

(10)

- All the abstract classes contains common reusable features & they always deals with common requirements.
- All the abstract classes ^{must} participates in inheritance. bcoz they contains common features
- Abstract class defns should not be final bcoz they always participates in inheritance.
- An object of abstract class can't be created directly but it can be created indirectly w.r.t. implementation class.
- Programmaticaly, an object of abstract class = an object of its implementation class
- Every abstract class of Java must contain implementation of a derived class. So, that whose object can be created indirectly.
- Abstract method should not be private & final.
- Abstract classes contains only abstract instance methods but not abstract static methods bcoz instance methods can do repeated operation. Whereas static methods can do one time operation.
- Abstract classes follows polymorphism principles for BL development & also follows dynamic binding for execution logic.
- The advantages of abstract class are
 - a. AppII takes less memory space

- Abstract methods of abstract class takes less method overhead cost whereas defined methods of concrete class takes more method overhead cost.
- An object of abstract class can be declared but it can't be referenced directly & we can reference it indirectly w.r.t implementation class.

Ex:- operations O1; // valid

O1=new operations(); // Invalid

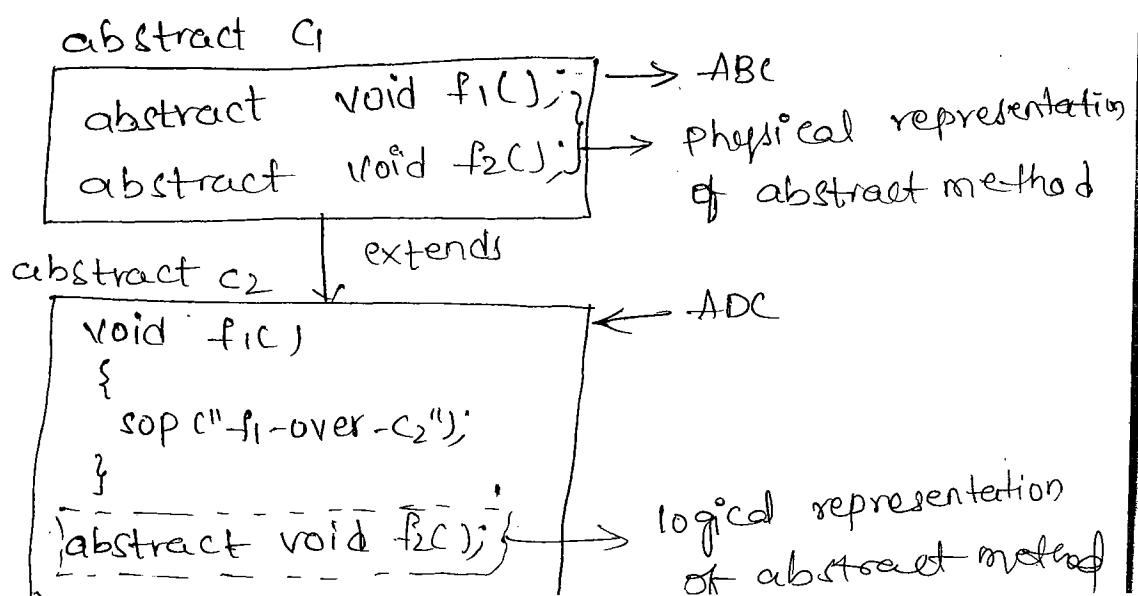
O1=new ISum(); // Invalid

→ An abstract class of Java can contain main method.

Abstract Base class & Abstract derived class

Defn of ABC :- An ABC always contains physical representation of abstract method which will always participates in inheritance process.

Defn of ADC :- An ADC contains logical representation of abstract methods which are inherited from ABC.



→ W.r.t ABC & ADC we can't instantiate their objects directly but we can create their objects indirectly w.r.t concrete implementation class.

→ To make the derived class as abstract, it has to satisfy the following properties.

a) If the DC is inheriting multiple abstract methods from abstract base class & if the derived class is not defining atleast one abstract method. Then, that DC defn must be made as abstract otherwise we get compile time error.

b) If the DC contains completely defined methods & if the DC programmer add physical abstract method. Then the DC defn must be made as abstract otherwise we get compile time error.

~~ABC's & ADC's~~ are always reusable until concrete class implementation formed.

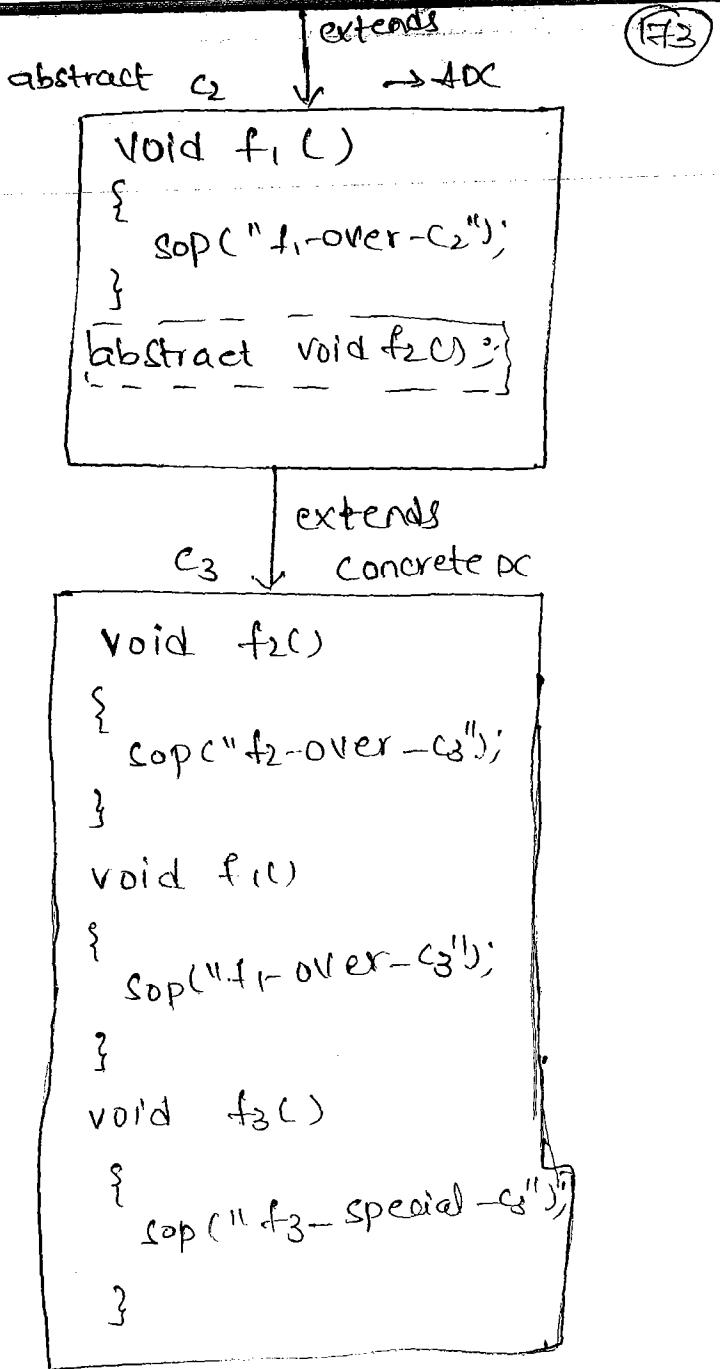
* write a Java program which illustrate the concept of ABC & ADC.

abstract C, → ABC

abstract void f1();

abstract void f2();

extends



*

II Ab Demo 4. Task

abstract class C₁

{
 abstract void f1();
 abstract void f2();
 abstract
 abstract void f3();
}

|| C₁ --- ABC

abstract C₂ extends C₁

{
 void f₁()

{

 Sop("f₁() --- overridden --- C₂");

}

} || C₂ --- ADC

class C₃ extends C₂

{
 void f₂()

{

 Sop("f₂() --- overridden --- C₃");

}

 void f₁()

{

 Sop("f₁() --- overridden --- C₃");

}

 void f₃()

{

 Sop("f₃() --- special --- C₃");

}

} || C₃ --- CDC

class AbDemo4

{
 public static void main(String[] args)

(48)

SOP("w.r.t C_3 --- direct object creation");

$C_3\ o_3 = \text{new } C_3();$

$o_3.f_1();$

$o_3.f_2();$

$o_3.f_3();$

SOP("w.r.t C_2 --- Indirect object creation - Dynamic binding");

" $C_2\ o_2 = \text{new } C_2();$ " Invalid, becoz C_2 is abstract

$C_2\ o_2 = \text{new } C_3();$

$o_2.f_1();$

$o_2.f_2();$

" $o_2.f_3();$ " Invalid, becoz $f_3()$ does not exist in C_2

SOP("w.r.t. C_1 --- Indirect object creation - Dynamic binding");

" $C_1\ o_1 = \text{new } C_1();$ " Invalid, becoz C_1 is abstract

" $C_1\ o_1 = \text{new } C_2();$ " Invalid becoz C_2 is abstract

$C_1\ o_1 = \text{new } C_3();$

$o_1.f_1();$

$o_1.f_2();$

" $o_1.f_3();$ " Invalid, becoz $f_3()$ does not exist in C_1 ,

" $o_1.f_3();$ " Invalid, becoz $f_3()$ does not exist in C_1 ,

}

}

Consequences in abstract classes

consequence:)

If any concrete class of Java contains purely null body methods then there is no use of calling null body methods w.r.t the corresponding concrete class object bcoz NBM will not give any result. Hence, such corresponding

concrete class defns must be made as abstract & they are called abstract concrete class.

Def of Null Body Method (NBM):-

A NBM is one of the defined method & it never contains block of stmts.

Syntax:-

Ret.type MethodName (list of formal parameters if any)

{

// Null Body

}

NBMs always exist in abstract concrete class & they must be overridden in implementation class of abstract concrete class.

* write a Java program which illustrate NBM's implementation

/* Abdemo5.java

abstract class Parent

{
 void goe(); // NBM
}

} // Parent --- ACC

class Child extends Parent

{
 void goe()
 {

 System.out.println(" going to college");
 System.out.println(" reading Java notes");

}

 } // Child of Parent

class Abdemos

(77)

{

 public static void main(*String args).

{

 System.out.println("w.r.t. Parent---dynamic binding");

 Parent p = new Child();

 p.goo();

}

}

Consequences

Industry is always recommended to override abstract methods of abstract classes but not defined methods of concrete class because method overhead cost of overriding abstract methods is less than method overhead cost of overriding defined methods of concrete class.

$$\begin{matrix} \text{Method overhead} \\ \text{cost for overriding} \\ \text{Defined method} \end{matrix} = \begin{matrix} \text{cost required for eliminating} \\ \text{existing body} \end{matrix} + \begin{matrix} \text{cost} \\ \text{required} \\ \text{for} \\ \text{constructing} \\ \text{new body} \end{matrix}$$

$$\begin{matrix} \text{Method overhead} \\ \text{cost for overriding} \\ \text{abstract method} \end{matrix} = \begin{matrix} \text{cost required for constructing} \\ \text{new body only} \end{matrix}$$

More method overhead cost reflects on more execution time & less method overhead cost reflects on less execution time

Q:- Can we make a concrete class as abstract?
give reason?

Ans:- Yes,

Reason :- See consequence ① [See previous page]

Interfaces

Limitations of Abstract classes :-

1. Abstract classes never participated in multiple inheritance
2. Abstract classes provides only common reusable features & unable to provide universal common reusable features.
3. WKT AC is a collection of defined methods & abstract methods. If we override defined methods of AC takes more execution time & overriding of abstract methods of interface takes less execution time. The overall execution time of abstract classes related apps is partially less & unable to provide completely less execution time.

Hence, to overcome the limitations of AC's in dealing with common requirements we use another concept called interface.

Interfaces-

Interface

(79)

- 1) The main intention of using interface concept is that
- 2) to overcome the limitations of abstract classes.
- 3) → Interfaces concept is used to develop universal user defined datatype.
- 4) → To develop universal user defined datatype with interface concept we use a keyword called Interface.
- 5) → Each & every interface name is programmatically treated as universal user defined data type.

Defn of Interface:-

Defn 1 An Interface is a collection of public static final xxx data members & public abstract methods
(Or)

Defn 2 An interface is a collection of universal common reusable data members & universal common reusable methods.

Syntax for defining an Interface :-

interface <intfName>

{

variable declaration &em Initialization
methods declaration

}

Explanation:-

→ Interface is a keyword used for developing universally user defined data type.

→ <intfName> represents a java valid variable name treated

In general interfaces provide rules/specifications to the implementation classes.

→ Programmatically, an object of interface can't be created directly but it can be created indirectly w.r.t implementation class

→ Variable declaration represents data members of the interface & they meant for data universally reusable. So, that they must be initialized otherwise we get compile time error since, interface data members are reusable, whose values can't be changed (final), whose memory space can be created only once (static) & they can be accessed every where (public). Hence, by default all the data members of interface belongs to

public static final XXX data members.

Ex:-

public static final float PI = 3.1417f;

Appended by Java
compilation Environment

written by Java
Programmer

→ Methods declaration represents set of undefined methods for performing universal operations. To make these undefined methods as abstract explicitly we need not to write abstract (by default abstract) & to make them universally accessible we need not to write public ^{hence} by default every method of interface belongs to public abstract

Ex:- public abstract
Appended by
Java compilation

void draw();
written by
Java programme

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(18)

- Eg: Define an interface Sathya by taking suitable DM's & Methods.

1) Sathya.java

interface Sathya {

 int a=10;

 int b=20;

 void f1();

 void f2();

}

→ compile the above program

javac Sathya.java

Ensure that Sathya.class file will be generated. In general for each & every interface defn also a .class file will be generated.

→ view the profile of Sathya interface

javap Sathya

interface Sathya {

 public static final int a;

 public static final int b;

 public abstract void f1();

 public abstract void f2();

 }

In general all the features of interface are by default belongs to public & hence features of interfaces are universally accessible

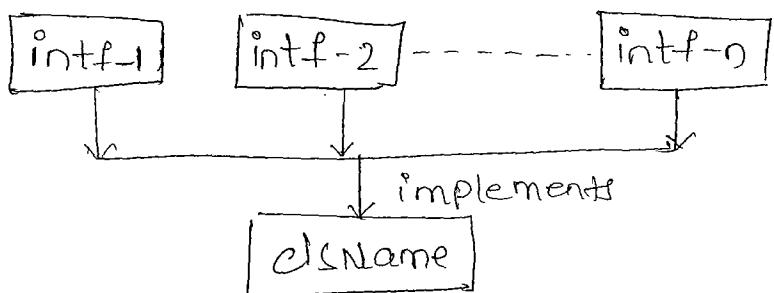
Inheriting the features of interfaces

In Java programming we've 3 approaches to inherit the features of interfaces. They are

Approach :-

This approach makes us to understand how to inherit the features from base interfaces into derived class

Diagram :-



Syntax :-

```
[abstract]class <classname> implements <intf-1>,<intf-2>...<intf-n>
{ }
```

Variable Declaration

method def / declaration

}

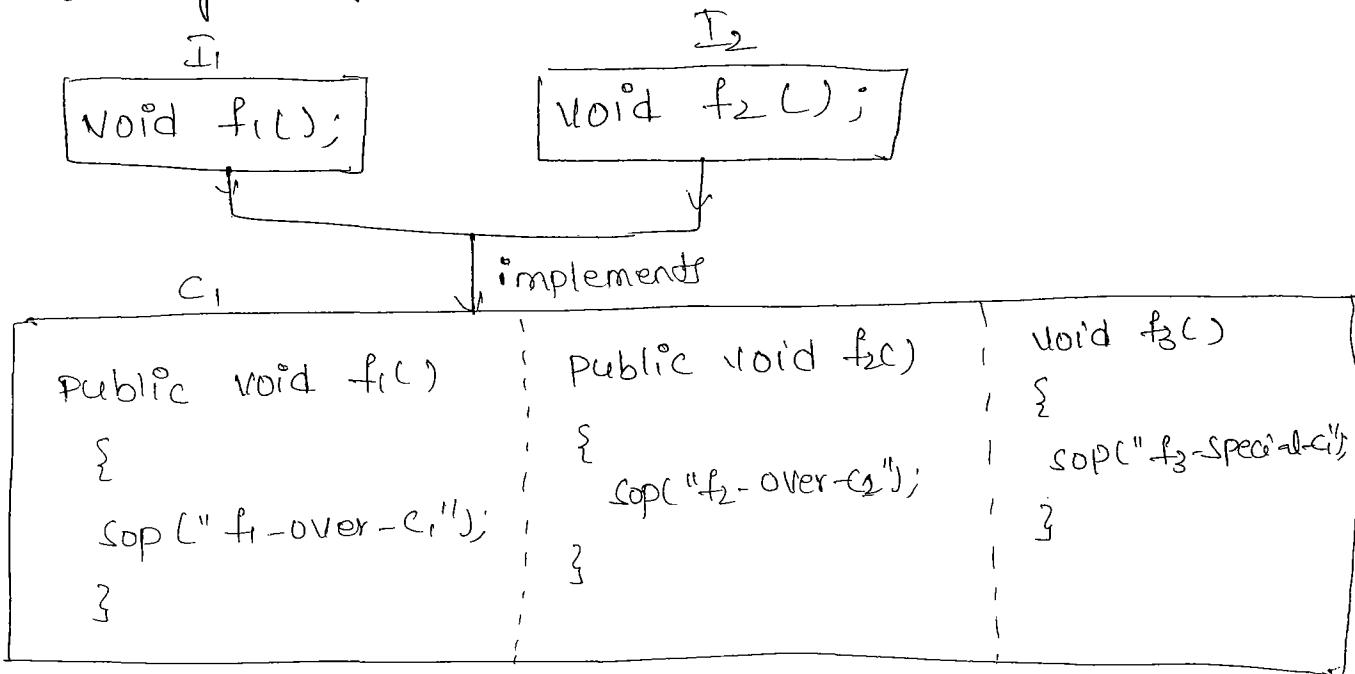
Explanation :-

In the above syntax

- ① <classname> represents name of the DC.
- ② <intf-1><intf-2>...<intf-n> represents name of the B.I's.
- ③ implements is a keyword which is used to inherit the features of ~~the~~ base interface(s) into DC + it provides

- In Java programming one DC can extends only one SC
- whereas one DC can implements either one or more than one interface because Java programming supports multiple inheritance through the concept of interfaces but not through classes concept.

* write a Java program which will implement the following diagram.



1) Intfprogl.java

interface I1

```
{
    public abstract void f1();
}
```

2) Intfprogl2.java

interface I2

```
{
    public abstract void f2();
}
```

3) C1.java

```
{
    public void f1()
}
```

{

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Sop("f₁() --- overridden --- c₁");

{

public void f₂()

{

Sop("f₂() --- overridden --- c₁");

{

void f₃()

{

Sop("f₃() --- Special --- c₁");

{

} || class

class Intfprogl.

{

public static void main(String[] args)

{

Sop("w.r.t c₁ -- Direct object creation");c₁ o₁ = new c₁();o₁.f₁();o₁.f₂();o₁.f₃();

Sop("w.r.t @I, -- In-direct object creation -- Dynamic binding")

If I, i₀₁ = new I₁(); invalid, bcoz I₁ is abstractI i₀₁ = new c₁();i₀₁.f₁();(* i₀₁.f₂(); invalid, bcoz f₂() & f₃() does not exist

in I

i₀₁.f₃(); *)

Q. Sop("w.r.t I₂ -- In-direct object creation - Dynamic binding");

If I₂ i₀₂ = new I₂(); invalid, becoz I₂ is abstract

I₂ i₀₂ = new C();

i₀₂.f₂();

* i₀₂.f₁(); invalid, becoz f₁() & f₃() does not exist in I₂

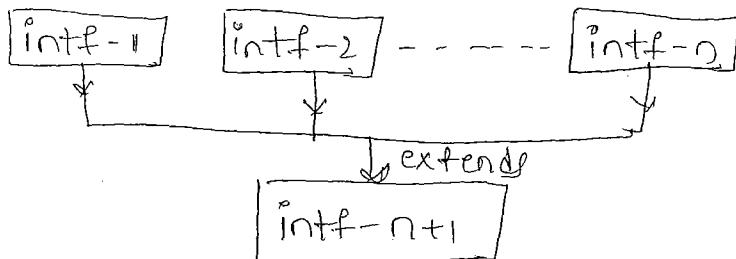
}

}

Approach :- [interface inheritance]

This approach makes us to understand how to inherit the features from base interface(s) into derived interface.

Diagram :-



Syntax :-

interface <intf-n+1> extends <intf-1>, <intf-2>, ..., <intf-n>

{

Variable declaration or initialization

method declaration

}

Explanation:-

In the above syntax

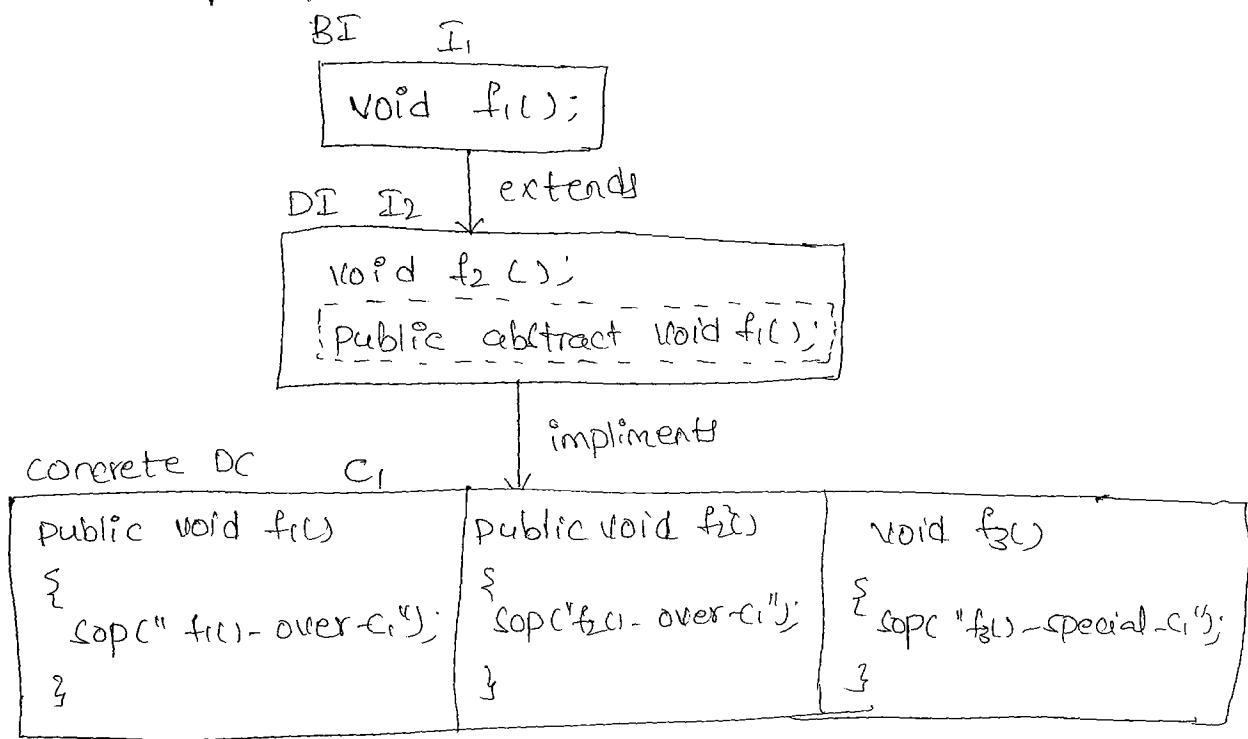
1. <intf-n+1> represents name of the derived interface

2. <intf-1> <intf-2>, ... <intf-n> represent name of the base interface

3. Extends is a keyword which is used to inherit the features of base interface into derived interface & it provides richest functionality to derived interface.

* In Java programming one derived class can extend only one base class whereas one derived interface can extends either one or more than one interface.

* write a Java program which will implement the following diagram



/* Intfprog2.java

interface I₁,

```
{  
    void f1();  
}  
/* I1
```

interface I₂ extends I₁,

```
{  
    void f2();  
    public abstract void f1();  
}
```

(87)

```

class C implements I2
{
    public void f1()
    {
        System.out.println("f1() --- overridden --- C1"); 
    }

    public void f2()
    {
        System.out.println("f2() --- overridden --- C2"); 
    }

    void f3()
    {
        System.out.println("f3() --- special --- C1"); 
    }
}

// class

class intfprog2
{
    public static void main(String[] args)
    {
        System.out.println("w.r.t C, Direct object creation");
        C1 o1 = new C1();
        o1.f1();
        o1.f2();
        o1.f3();
    }

    System.out.println("w.r.t I, In-direct object creation - Dynamic binding");
    // I1, i01 = new I1(); invalid, bcz I1 is abstract
    I1 i01 = new C1();
    i01.f1();
}

```

(18) /* i01. f2(); invalid, bcoz f₂ & f₃ do not exist in I₁
*i02. f₃(); */*

SOP (" w.r.t I₂, In-direct object creation - dynamic binding ");

// I₂ i02 = new I₂(); invalid, bcoz I₂ is abstract

I₂ i02 = new C₁();

i02. f₂();

/* i02. f₃(); invalid, bcoz f₁₍₎ & f₃₍₎ does not exist in I₂

i02. f₁(); ~~***~~

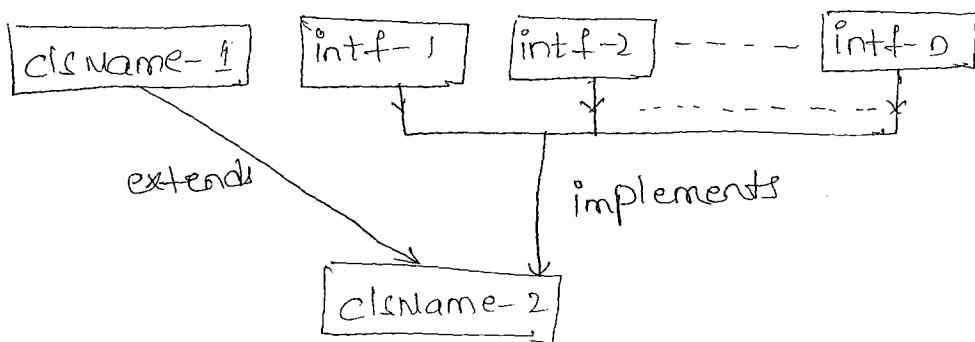
}

}

Approach-3 [Parallel Inheritance]

In this approach we understand how to inherit the features of base class & base interfaces into derived class.
 [Known as parallel inheritance]

Diagram :



Syntax :

[Abstract] class <clsName-2> extends <clsName-1>
 implements <intf-1> <intf-2> ... <intf-n>

{

variable declaration;

method defn/declaration;

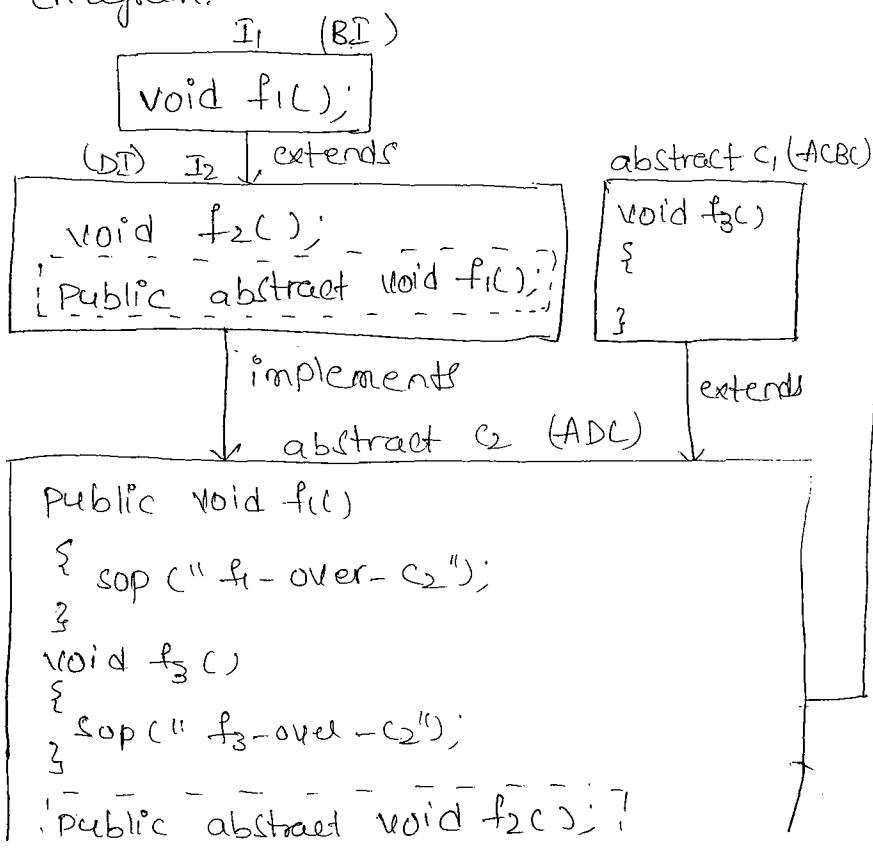
Explanation:

(89)

In the above syntax

1. <classname-1> & <classname-2> represents name of the base & derived classes
2. <intf-1> ... <intf-n> represents name of the base interfaces
3. Here extends & implements are the 2 keywords used for inheriting the features of base class & base interface's parallelly into derived class. + they provides richest functionality to the DC.
4. When we use both extends & implements keywords in a simple Java program then it is mandatory to the Java programmer to use extends keyword word first & later we use implements keyword. otherwise we get compile time error.

* Write a Java program which will implement the following diagram.



c3 → extends (CDC)

```

public void f2()
{
    sop("f2-over-c3");
}
public void f1()
{
    sop("f1-over-c3");
}
void f3()
{
    sop("f3-over-c3");
}
void ful()
{
    sop("ful-special-c3");
}
  
```

// intfprogs.java

(190)

interface I₁

{

 void f1(); // public abstract void f1()

} // I₁ - Base interface

interface I₂ extends I₁

{

 void f2(); // public abstract void f2()

} // I₂ - Derived interface

abstract class C₁

{

 void f3(); // Null body method

{

} // C₁ - Abstract concrete base class

abstract class C₂ extends C₁ implements I₂

{

 public void f1()

{

 System.out.println("f1() -- overridden -- C₂");

}

 void f3()

{

 System.out.println("f3() -- overridden -- C₂");

}

} // C₂ -- abstract derived class

class C₃ extends C₂ (191)
{
 public void f₂()
 {
 System.out.println("f₂() -- overridden -- C₃");
 }
 public void f₁()
 {
 System.out.println("f₁() -- overridden -- C₃");
 }
 void f₃()
 {
 System.out.println("f₃() -- overridden -- C₃");
 }
 void f₄()
 {
 System.out.println("f₄() -- special -- C₃");
 }
}
} || C₃ -- concrete derived class

class IntfProg₃
{
 public static void main(String[] args)
 {
 System.out.println("w.r.t C₃ - Direct object creation");
 C₃ o₃ = new C₃();
 o₃.f₁();
 o₃.f₂();
 o₃.f₃();
 }
}

SOP ("w.r.t. \mathcal{G}_2 - indirect object creation - dynamic binding");
 \mathcal{G}_2

// $\mathcal{G}_2 \circ_2 = \text{new } \mathcal{G}_2();$ invalid, bcoz \mathcal{G}_2 is abstract

$\mathcal{G}_2 \circ_2 = \text{new } \mathcal{G}_1();$

$\circ_2.f_1();$

$\circ_2.f_2();$

$\circ_2.f_3();$

// $\circ_2.f_4();$ invalid, bcoz f_4 does not exist in \mathcal{G}_2

SOP ("w.r.t. \mathcal{C}_1 - indirect object creation - dynamic binding");

// $\mathcal{C}_1 \circ_1 = \text{new } \mathcal{C}_1();$ invalid, bcoz \mathcal{C}_1 is abstract

// $\mathcal{C}_1 \circ_1 = \text{new } \mathcal{G}_2();$ invalid, bcoz \mathcal{G}_2 is abstract

$\mathcal{C}_1 \circ_1 = \text{new } \mathcal{G}_3();$

$\circ_1.f_3();$

(* $\circ_1.f_1();$ invalid, bcoz $f_1()$, $f_2()$ & $f_4()$

$\circ_1.f_2();$ does not exist in \mathcal{C}_1

$\circ_1.f_4();$ *)

SOP ("w.r.t. \mathcal{I}_2 - indirect object creation - dynamic binding");

// $\mathcal{I}_2 \circ_2 = \text{new } \mathcal{I}_2();$ invalid, bcoz \mathcal{I}_2 is abstract

// $\mathcal{I}_2 \circ_2 = \text{new } \mathcal{G}_2();$ invalid, bcoz \mathcal{G}_2 is also abstract

* $\mathcal{I}_2 \circ_2 = \text{new } \mathcal{C}_1();$ invalid, bcoz \mathcal{C}_1 is also abstract

$\mathcal{I}_2 \circ_2 = \text{new } \mathcal{G}_3();$

$\circ_2.f_1();$

$\circ_2.f_2();$

(* $\circ_2.f_3();$ invalid, bcoz $f_3()$ & $f_4()$ does not

$\circ_2.f_4();$ *) exist in \mathcal{I}_2

SOP ("w.r.t. \mathcal{I}_1 - indirect object creation - dynamic binding");

// $\mathcal{I}_1 \circ_1 = \text{new } \mathcal{I}_1();$ invalid, bcoz \mathcal{I}_1 is abstract

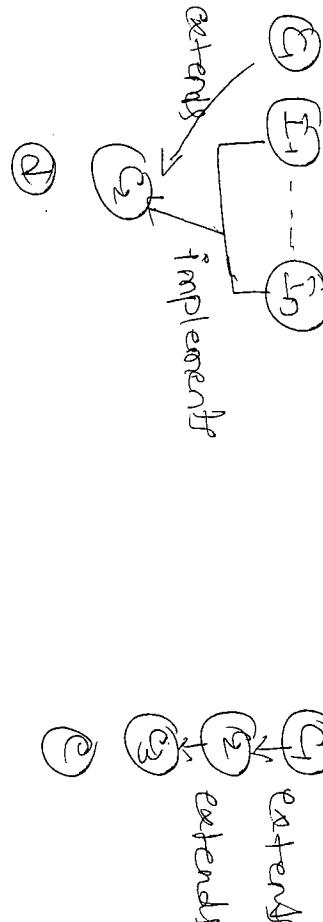
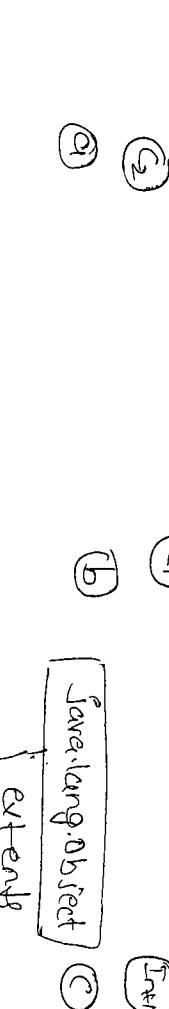
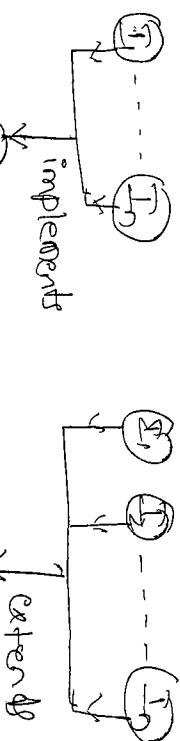
0 // I₁, i01=new I₂(); invalid, becoz I₂ is also abstract
 1 // I₁, i01=new C₁(); invalid, becoz C₂ is also abstract
 2 I₁ i01=new C₃();
 3 i01.f1();
 4 * i01.f2(); invalid, becoz f₂(), f₃() & f₄() does
 5 i01.f3(); not exist in I₁,
 6 i01.f4(); */
 7 }
 8 }

points to be remembered in interfaces:

1. Interfaces always contains universal common reusable features.
2. All the interfaces in Java must participated in inheritance.
3. Interface defns should not be final.
4. Interface defns should not contain defined main methods.
5. While we are defining interface methods in the context of derived class, interface methods must be preceded by public otherwise we get compile time error.
6. Interfaces will not contain implicit pre defined super class whereas class still contains implicit pre defined super class
7. Every interface must contain an implementation class to create its object indirectly.
8. Interfaces of Java never contains constructors, static blocks & instance blocks becoz data members of interface already initialized.
9. An object of an interface can be declared but it can't be referenced directly.
10. Interfaces contains only static data members but not containing instance data members.

11. The modifier of the interface is by default abstract

Note :-



C₁ not possible

← not possible



class C₁ implements I₁

{

==

(b)

The super class of implementation of class C₁ is

java.lang.Object

Inner/ Nested Interfaces :-

(195)

WKT normal interface of Java contains collection of abstract methods. If any class implements the normal interface which contains collection of abstract methods then the implementation class needs to define interested methods along with uninterested methods which is time consuming proc. If we are not defining uninterested methods the current implementation class will become abstract & we can't call interested method. Which is not a recommended procedure.

To overcome these programmatic difficulties of normal interfaces, we've one another called nested/ inner interface.

Defn of inner/nested interface :-

If we define an interface "y" inside of an another interface "x" then the interface defn "x" is called outer interface & defn of interface "y" is called inner/nested interface.

Def of container ship:-

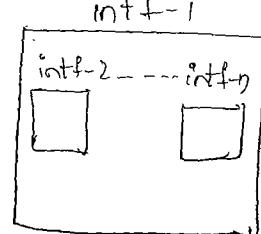
The process of defining one interface defn inside of another interface defn is called "container ship".

Syntax:-

```
interface <intf-1>
{
    -----
    interface <intf-2>
    {
        -----
    }
}
```

```
interface <intf-n>
```

```
{ -----  
    -----  
    -----  
    }  
    }
```



To access inner interfaces^(Q) in syntax-1 we write `<intf1><intf2>` and `<intf-1>.<intf-n>`.

NOTE:-

When we compile the above inner interface program we get the .class file as follows.

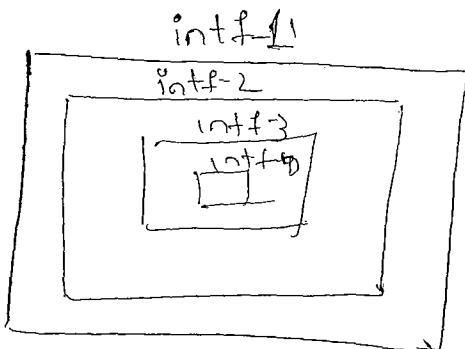
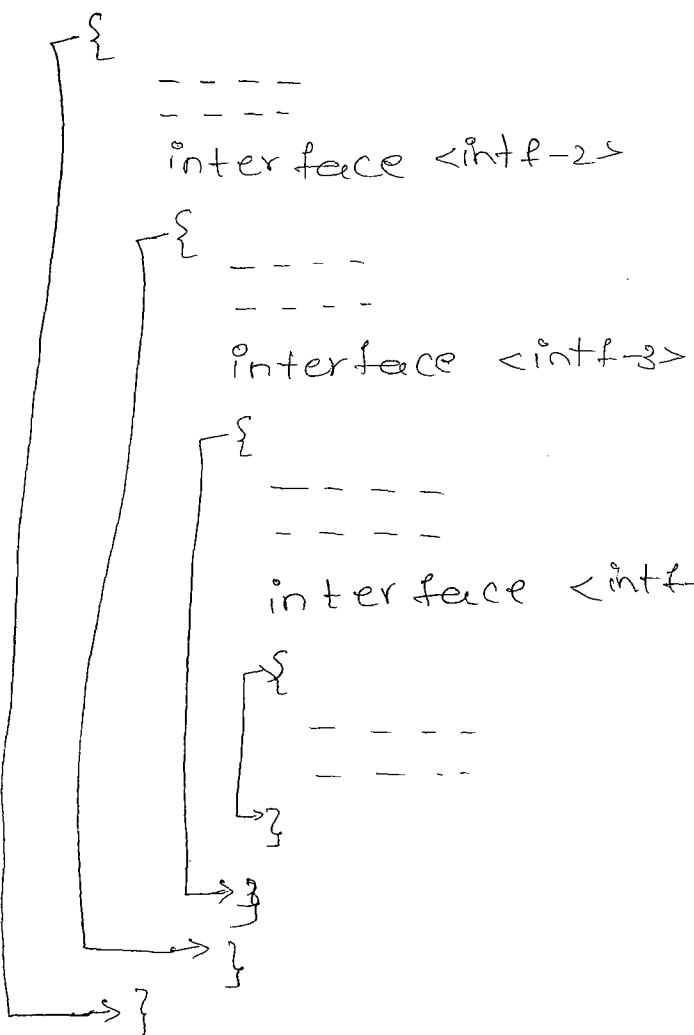
`<intf-1>.class`

`<intf-1> & <intf-2>.class`

`<intf-1> & <intf-n>.class`

Syntax-2 :-

interface `<intf-1>`



To access inner most interface we write `<intf-3>.intf-2`

`<intf-3>---<intf-2>`

Advantages of inner interface

when we develop any java app with the concept of inner interfaces we get the following advantages

1. They allowed to define interested abstract methods by leaving uninterested abstract methods.
2. Inner interfaces related apps gives less app development time & whose overall performance is enhance.
- * write a java program which illustrate the concept of inner interfaces.

// InnerIntfDemo.java

interface SathyaTech

{

void PayFees();

interface Java

{

void LearnJava();

} // Java --- inner intf

interface DotNet

{

void LearnDotNet();

} // DotNet - inner intf

} // SathyaTech - outer intf

(198) class JavaStudent implements SathyaTech, SathyaTech.Java

{

 public void learnJava()

{

 System.out.println("Learning Java");

}

 public void payFee()

{

 System.out.println("Paid Fee");

}

} // JavaStudent -- Impl class

class InnerIntfDemo

{

 public static void main(String[] args)

{

 System.out.println("Want SathyaTech, SathyaTech.Java - Indirect
 object creation - dynamic binding");

 SathyaTech st = new JavaStudent();

 st.payFee();

 SathyaTech.Java si = new JavaStudent();

 si.learnJava();

 System.out.println("Want JavaStudent - - Direct object creation");

 JavaStudent js = new JavaStudent();

 js.learnJava();

 js.payFee();

}

* Develop a Java app for performing arithmetic operations on integers & floats with inner interface concept

// InnerIntfDemo.java

interface AOP

{

interface Sum

{

void int();

void float();

}

interface Sub

{

void int();

void float();

}

interface Mul

{

void int();

void float();

}

interface Div

{

void int();

void float();

}

} // AOP

class C implements Aop.Sum

200

{

public void intc()

{

SOP("operation on integers");

}

public void floatc()

{

SOP("operation on floats");

}

}

class InnerIntfDemo

{

public static void main(String args)

{

SOP("w.r.t C1 - direct object creation");

C1 * S1 = new C1();

S1.intc();

S1.floatc();

SOP("w.r.t AOP - indirect object creation - dynamic binding");

AOP S2 = new C1();

S2.floatc();

AOP-Sum S3 = new C1();

S3.summ(intc);

}

}

Functional Interface & Q1

- It is one of new concept/feature available in JDK 1.8 version onwards.
- Def: An interface is said to be a functional interface if & only if it contains only one abstract method.
 - In ordinary programming of Java every interface method must be defined in the implementation class.
 - In Java programming one can also implement/define abstract methods of interfaces without implementation classes. i.e, by using the concept of anonymous inner classes.
 - Most of our real time apps the abstract methods of functional interfaces overridden in anonymous inner classes rather than explicit implementation classes.

* Write a Java program which illustrate the concept of anonymous inner class for implementing functional interface methods.

18/15 4 Satya.java

```
interface India
{
    void makeIndia();
}

// India - functional Interface

class Satya
{
    public static void main (String args)
    {
        India Iobj = new India()
        {
            public void makeIndia()
            {
                System.out.println("India is Great");
            }
        };
        Iobj.makeIndia();
    }
}
```

```

    }  

    System.out.println("makeIndia() -- overridden in AINC");  

}  

};  

id.makeIndia();  

India id2 = new India()  

{  

    public void makeIndia()  

    {  

        public void makeIndia()  

        {  

            System.out.println("makeIndia() -- overridden in another AINC");  

        }  

    };  

    id2.makeIndia();
}
}

```

When we compile the above program internally Java environment created 2 anonymous inner classes namely Sathya\$1 & Sathya\$2. Here 1 & 2 are called anonymous inner classes which are implementing an interface India & providing different implementations for makeIndia() method.

* Write a Java program for performing swapping of integers & string data by using functional interfaces with anonymous inner classes by accepting the values dynamically.

```

//SathyaTech1.java
import java.util.Scanner
interface Swap
{

```

203

```

Void swapValues();
} // swap - functional interface

class SwapTech
{
    public static void main( String [] args)
    {
        new Swap()
        {
            public void swapValues()
            {
                Scanner s = new Scanner (System.in)
                System.out.println("Enter first int Val");
                int a= Integer.parseInt(s.nextLine());
                System.out.println("Enter second int Val");
                int b= Integer.parseInt(s.nextLine());
                System.out.println("Original value of a=" + a);
                System.out.println("Original value of b=" + b);
                int t=a;
                a=b;
                b=t;
                System.out.println("Interchanged value of a=" + a);
                System.out.println("Interchanged value of b=" + b);
            }
        }.swapValues(); // calling the method with nameless object
    }
}

```

203

```

public void swapValues()
{
    Scanner s = new Scanner (System.in);
    System.out.println("Enter first string Val");
    String a = s.nextLine();
}

```

```

        System.out.println("Enter second String val");
        String b = s.nextLine();
        System.out.println("original value of a=" + a);
        System.out.println("original value of b=" + b);
        String t = a;
        a = b;
        b = t;
        System.out.println("Interchanged value of a=" + a);
        System.out.println("Interchanged value of b=" + b);
    }
}

}.swapValues();
}
}

```

Q:- Can we implement the abstract methods of interface without implementation class?

Ans:- yes, wrt anonymous inner class.

Marker/ Tagged interface

MI doesn't contain any abstract methods explicitly (Implicitly there exists some abstract methods which are JVM dependable overridden methods) & it provides run time behaviour to the implementation class of marker interface

Ex- java.lang.Cloneable

java.io.Serializable

java.rmi.Remote etc

write a Java program which will display fonts of the system.

// FontsProgram.java

import java.awt.GraphicsEnvironment;

class FontsProgram

(205)

{

 public static void main(String[] args)

{

 GraphicsEnvironment ge = GraphicsEnvironment.getLocal

 GraphicsEnvironment();

 String f[] = ge.getAvailableFontFamilyNames();

 System.out.println("no. of fonts = " + f.length);

 // printing the fonts

 for (int i=0; i < f.length; i++)

 {

 System.out.println(f[i]);

 }

}

}

→ In the above program Graphics Environment is one of the predefined abstract class present in java.awt.* package.

→ GraphicsEnvironment . class contain the following factory method

public static GraphicsEnvironment getLocalGraphicsEnvironment()

Eg:- GraphicsEnvironment ge = GraphicsEnvironment.getLocalGraphicsEnvironment();

→ To get the fonts from the current working machine we use the following method which is present in GraphicsEnvironment class

public String[] getAvailableFontFamilyNames()

Eg:- String[] f = ge.getAvailableFontFamilyNames();

→ Packages :-

(Q5)

In any programming language there exist a library where it contains common features for most of the programmers.

For example, in C-programming whose library contains collection of header files & it is a collection of pre-defined common funcns. In C devlopment if any function is common for most of the programmers then such type of funcns will be placed in header file. In otherwords, header files always contains common funcns.

Similarly, in Java programming, it contains rich set of API (App II programming interface)

Def :- An API is a collection of packages. A package is a collection of classes, interfaces & sub packages. A subpackage interns collection of classes, interfaces & sub sub packages.

etc.

* The purpose of package concept is that when the class & interface is common for most of the Java programmers then those common classes & interfaces must be placed in the package. In otherwords, packages are always containing common classes & interfaces.

Advantages of Packages :-

If we develop any Java app II with the concept of packages then we get the following advantages.

1. App II development time is less

2. App II memory space is less

- 3. App execution time is less. QCF
- 4. App performance is enhanced.
- 5. App redundancy of code is minimized.
- 6. Able to get the slogan of Java (WORA)
- 7. we are able to differentiate/provide uniqueness among duplicate classes.

Q1:- What is the difference b/w inheritance & package

Ans:- Inheritance concept always makes us to understand how to reuse the features within the program b/w class to class, interfaces to interface & interfaces to class but not across the programs.

packages concept allows to reuse the features both within & across the programs b/w class → class, interfaces → interface & interface → class.

Type of Packages in Java :-

We've 2 types of packages they are

1. Pre-defined/Builtin packages
2. User/Programmer/System defined packages.

Pre defined packages :-

These are developed by SUN micro system developers available as a part of Java SW & whose role is to deal with universal requirements.

User defined packages are developed by Java programmers available as a part of Java project & they always deals with common requirements.

Type of Pre defined Packages:-

We've 3 types of pre defined Packages . They are

i) J2SE (Core) package :-

The purpose of these packages is to develop client side app's.

ii) J2EE (Advanced) packages :-

These packages are used for developing server side app's.

iii) J2ME (Mobile micro) packages :-

These packages are used for developing mobile / wireless app's.

List of pre defined J2SE Packages :-

J2SE contains 8 essential packages. They are

1. Java.lang.* :-

Now it is one of the pre defined package & it is always used for obtaining language facilities / services.

Some of the language facilities are .

a, Accepting command line arguments

b, Data conversions

c, Obtaining the garbage collection facility

d, Developing the thread based app's

e, Developing the exception based app's. etc.

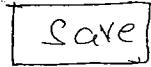
By default this package is imported to each & every java program & hence this package is called default package.

2. Java.awt.* (Abstract windowing Tool Kit)

The purpose of this package is to design GUI app's (look&feel)

- To design the GUI appli we need GUI components which are available in the form of pre defined classes.
- Ex :- Label, Button, checkbox, Textfield etc.
- Creating a GUI component is nothing but creating an object of an appropriate pre defined class.
- Ex :- Create a Button with a name Save

Button b1 = new Button ("Save");



3. Java.awt.event.* :-

Here event is the sub package of awt package. Event package contains collection of classes & interfaces & they provides functionality/behaviour to the GUI appli.

To develop the complete GUI appli we must import Java.awt.* & Java.awt.event.*

4. Java.io.*(File programming)

The purpose of this package is to achieve the data persistence by using the concept of files.

Defn of Stream :-

The flow of data b/w main memory & secondary memory

is known as stream.

5. Java.applet.* :- (Applet programming)

The purpose of this package is to develop distributed apps where they can run in the context of browser & whose results are sharable across the universe.

To develop the distributed apps, in the initial version of Java Sun's developer developed a concept called applets

To fulfill the concept of ⁽²⁾applets, we have predefined class called Applet present in `java.applet.*`

Defn of applet :-

An applet is one of the Java program which are running in the context of browser & whose results are sharable across the universe.

6. Java.net.* :- (Network programming)

The purpose of this package is to develop n/wing apps (one client server apps) for sharing the data b/w multiple machines which are located either in same n/w (or) in different n/w.

For developing client & server side apps there exist separate classes & interfaces which are present in `Java.net.*` package.

7. Java.util.* :- (Collection Framework)

The purpose of this package is to develop high performance Java based apps.

Defn of collection framework:-

It is one of the standardized mechanism which allows to group multiple values either of same type (or) different type (or) both the types in a single variable with a dynamic size. This single variable is called collection framework variable.

8. Java.text.* :- (Text processing)

This package is used for 3 purposes. They are

(i) Formatting of dates

(ii) Formatting of times

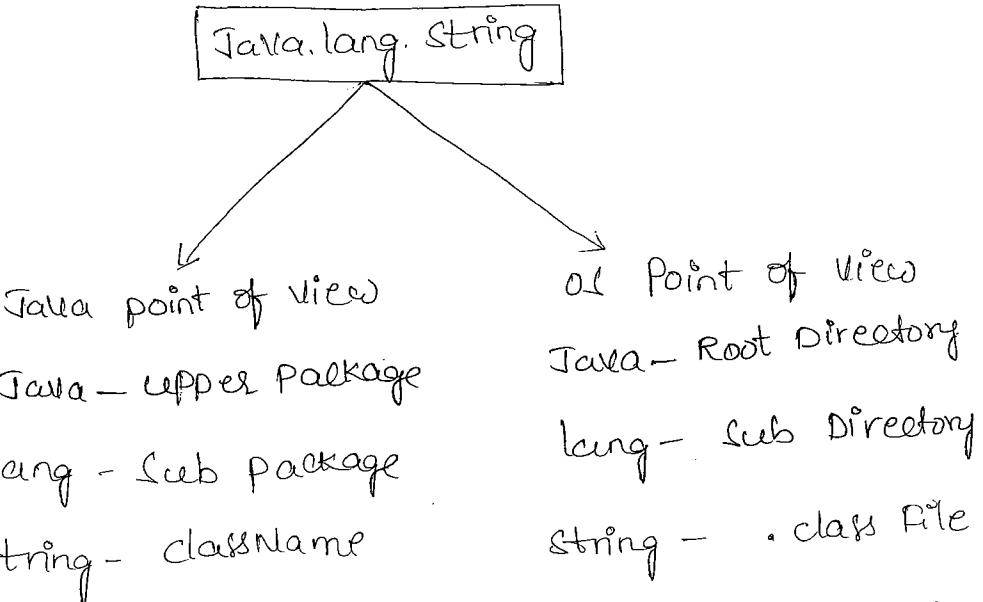
(iii) Numerical manipulations like truncating, rounding, ceiling, floating etc.

In other words, this package (Q1) we use most of the times in report generation modules.

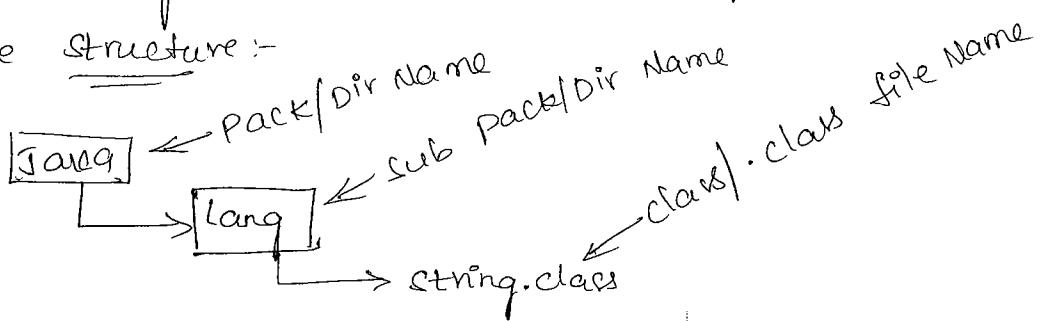
Development of user/ programmer defined packages:-

The purpose of creating user defined package is that to place common classes & interfaces. In other words, if a class (or) interface is common for most of the programmers then such type of classes & interfaces must be placed in a package. What are all the guidelines are followed by SUN MS developers for developing pre defined package same guidelines will be followed by Java programmers for developing user defined packages.

Creating a user defined package is nothing but creating it as a directory / folder in current working machine.
Consider the following statement



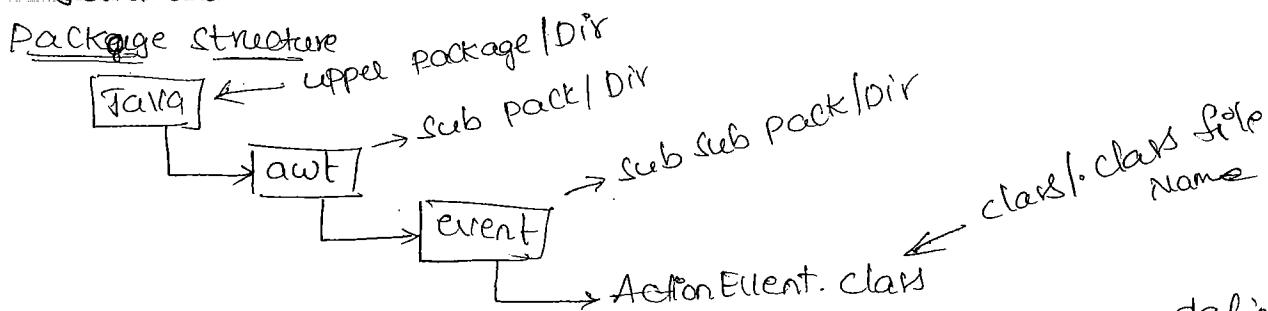
Package Structure :-



consider the following statement

(Q12)

Java.awt.event.ActionEvent



No. of phases required for Developing & using user defined packages:-

To develop & use the user defined packages we've 4 phases.

They are.

1. create a package
2. place the classes & interfaces defns in the package
3. compile the classes & interfaces of a package.
4. use the classes & interfaces of a package.

Phase 1:-

creating the package.

To create a package we use the following syntax.

```
Package pack1 [pack2 [--- [packn]]];
```

Explanation:-

1. Here package is one of the keyword used for creating user defined packages.
2. pack1, pack2 ... packn represents Java valid variable names treated as ADP.
3. pack2, pack3 ... packn represents name of the sub packages initialisation is optional

4. Pack1 represents name^(Q13) of the upper package & whose specification is mandatory.

Ex:- Package P1;

(or)

Package P1, P2;

} Package

Statement

Rule :-

When we are placing class defn (or) interface defn in the package, the packages statement must be 1st executable Stmt otherwise we get compile time error.

Phase :-

Steps for placing class/ interface defn in the package :-

To place class & interface defns in the package we follow the following steps.

1. Choose an appropriate package name for placing common classes & interfaces & ensure that the package stmt must be 1st executable Stmt.
2. Choose an appropriate class/ interface name & ensure that whose modifier must be public
3. The modifier of the constructor of the class which is present in the package must be public (this rule is not applicable in the case of interfaces)
4. The modifier of the method of the class / interface which is present in the package must be public (this rule is optional in the case of interfaces)
5. Whatever the class/ interface name we are placing in the package must be given as a filename with an extension .java.
6. At any point of time in one package we must define either a class defn (or) interface defn otherwise we get file recognition problem in run time (Bcz multiple public classes/ interfaces never permitted)

Ex: create a package tp & place a class Test

1) Test.java → ⑤

package tp; → ①

public class Test → ②

{

 public Test() → ③

{

 System.out.println("Test--DC");

}

 public void disp() → ④

{

 System.out.println("Test--disp()");

}

} // Test -- common BLC

Ex: create a package tp & place an interface Test

1) ITest.java → ⑤

package tp; → ①

public interface ITest → ②

{

 → ③ not applicable

 public void show() → ④ optional

{

}

}

Phase 3

(Q15)

compiling classes & interfaces of a package

To compile the package classes & interfaces we use the following syntax.

```
JavaC -d . filename.java
```

Explanation :-

1. Here -d is one of the directory option/switch, which gives an indication to the Java environment saying that go to file name.java, take the package name & create it as a directory automatically in the current working machine provided the following conditions must be satisfied.

i, filename.java should not contain any errors

ii, Earlier the package name should not be created as a directory (if it is already created as a directory then it will be carry forwarded without re-creating it) & will be considered as a current directory.

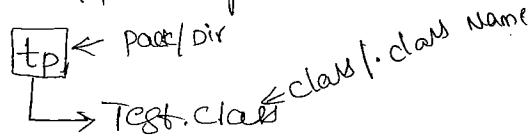
2. JavaC is a tool used to compile .java programs & generates .class files.

3. dot(.) referred current directory. Due to dot(.), currently

generated .class files will be automatically copied into currently created directory (Package name in the java program)

Ex:- compile Test.java

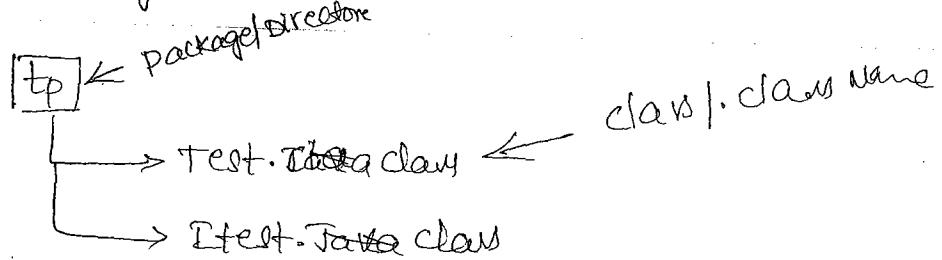
Ex:- `cd C:\Users\Aman\IdeaProjects\Java\src` JavaC -d . Test.java



Ex- compile Itest.java

(Q16)

E:\111AM\Java\packages>javac -d . Itest.java



The fully qualified names of `Test` class & `Itest` interface are `tp.Test` & `tp.Itest`.

* Write a Java program which makes use of `Test` class of `tp` package

// PackDemo1.java

```
import tp.Test;
class PackDemo1
{
```

```
    public static void main(String args)
```

```
{
```

```
    Test t1 = new Test();
```

```
    t1.display();
```

```
}
```

```
}
```

* write a Java program which makes use of `Itest` interface of `tp` package.

// PackDemo2.java

```
class PackDemo2
```

```
{
```

```
    public static void main(String []args)
```

```
{
```

```
    tp.Itest io = new tp.Itest();
```

```
S
```

```

    public void show() { Q17
        {
            System.out.println("overridden - A[1c]");
        }
    }

    public void show() {
        System.out.println("A[1c]");
    }
}

```

Phase :- 4

No. of phase to use the classes & interfaces of a package

In Java programming we've 2 ways to use the classes & interfaces of a package.

1. By using import statement
2. By using fully qualified name/canonical form approach

By using import statements

The purpose of import stmt is that either referring of all the classes & interfaces of a package (or) a particular class (or)

interface of a specific package in the current Java program.

The import stmt can be used in various approaches. They are.

Approach :- 1

This approach makes us to understand how to refer all the classes & interfaces of a particular package in the currently working Java program.

Syntax:-

```
import pack1.[pack2 [... [pack n]]] *;
```

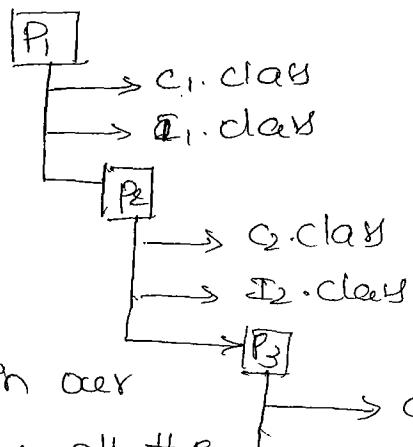
Here "*" is called a wild character which gives an indication to Java environment saying that provide all the classes & interfaces present in the specified package at both compile & execution time.

Ex:-

import P1.*; → ①

import P1.P2.*; → ②

import P1.P2.P3.*; → ③



→ If we use stmt ① in our

Java program we can refer all the classes & interfaces of P1 package

but not the classes & interfaces of P2 & P3 packages

→ When we use stmt ② in our Java program we can refer

all the classes & interfaces of P2 package but not the classes & interfaces of P1 & P3 packages.

Approach :- 2

This approach makes us to understand how to use a class (8v) interface of a particular package.

Syntax:-

```
import pack1[.pack2[....[.pack n]]].class/intf name;
```

Ex:- import P1.C1; → ①

import P1.P2.I2; → ②

import P1.P2.P3.C3; → ③

→ When we use stmt ① in our Java program we can refer only the class C1 but not other classes & interfaces of same package P1.

Industry is always recommended to use only approach -2 becoz it is more organized classes & interfaces & not recommended to use approach 1.

• results in more memory space. (29)

*Static import statement - (SIS)

It is one of the new facility present in JDK 1.5 Version onwards.

The purpose of SIS is that eliminating the redundant referring of class names^{classname} before static data members & eliminating the redundant referring of class name before static method name.

Approach :-3

This approach applicable to static data members which are present in classes & interfaces. This approach makes us to refer directly in the LDM's without preceded by class/intf name.

Syntax:-

```
import static pack1[.pack2[....[.packn]]].cls[intf name].SDM Name;
```

Approach :-4

This approach applicable to static methods present in class. This approach makes us to refer static methods directly without preceded by cls name.

Syntax:-

```
import static pack1[.pack2[....[.packn]]].clsname.SM Name;
```

Approach:-5

This approach makes us to understand refer the static features (SDM & SM) directly without preceded by class/intf name.

Syntax:-

```
import static pack1[.pack2[....[.packn]]].cls[intf name].*
```

* Write a Java program which illustrate the concept of static import stmt (Q2)

// SIM Demo.java

```
/*import static ip.Inst.name;
import static ip.Inst.loc;
import static ip.Inst.crs; (OR) */
import static ip.Inst.*;
/*import static java.lang.Math.PI;
import static java.lang.Math.E;
import static java.lang.Math.pow;
import static java.lang.Math.sqrt; (OR) */
import static java.lang.Math.*;
import static java.lang.System.out;
```

Class SIMDemo.

```
{
    public static void main(String[] args)
    {
        out.println("Inst Details");
        out.println(" = = = = = = = = ");
        out.println(" Inst Name=" + name);
        out.println(" Inst Loc=" + loc);
        out.println("Inst course=" + crs);
        out.println(" = = = = = = = = ");
        out.println(" Math Details");
        out.println(" Val of PI=" + PI);
        out.println("Val of e=" + E);
        out.println(" pow(7,4)=" + pow(7,4));
        out.println(" pow(4,2)=" + pow(4,2));
        out.println(" sqrt(625)=" + sqrt(625));
```

Q:- What is the role of static keyword in Java?

We apply the static keyword in the following levels

1. At data member level called Static Data Member (SDM)

2. At method level called Static Methods (SM)

3. At block level called Static block (SB)

4. At import stmt level called Static import (SIM)

Q:- What are the differences b/w import & package Keyword?

import

→ import is a keyword used → package is a keyword used for referring classes & interfaces to create user defined packages of a package.

→ We can write any no. of → package stmt should appear import stmt in a java program only once in a java program after package stmt.

→ We can apply static keyword → we can't apply static keyword during import stmt during package creation.

By using fully qualified name approach:-

→ If class name (or) interface name is qualified by its complete package hierarchy then it is called fully qualified name of a package.

→ It is an alternative approach for referring the class & intf instead of using import stmt.

→ If we refer a class/intf name multiple times with this approach in all the times they must be preceded by package name otherwise we get compile time error.

Syntax:-

Pack1[Pack2[...[Packn]]].Class/intf name

Ex:-

class Sathya extends P₁, C,

{
=

(22)

FQNA (Fully qualified

name approach)

Ex :-2

class Hyd implements P₁, P₂, P₃, I₃

{
=

FQNA

[Fully qualified name
approach)

Ex :-3

P₁. P₂. C₂ O₂ = new P₁. P₂. C₂();

FQNA

[Fully qualified name approach]

* b4 AJP

2018

Access Specifiers (or) Modifiers : AM are applied at 2 levels

① At class level: public
public abstract derived
public final AM's
final

Access modifiers are those which are applied before the class defns & instance defns whereas access specifiers are those which are applied before the data members & methods.

In Java programming we have 4 types of Access Specifiers. They are, ② At features of class level & before the features of class level we can apply these AM's

1. private,

2. default (not a keyword)

3. protected

4. public

If we are not writing ^{using} either private or protected ^{as} keywords public then JVM is by default treated as "default" access specifier modified.

The purpose of access specifiers is "how to access the features within & across the packages. Between class to class, interfaces to interface controlling mechanism

(223)

Access specifiers always makes us to understand where to access the features & where not to access the features (or) Access specifiers always provides features controlling accessing mechanism.

Rules for Access ~~Specifiers~~ ^{modifiers}

Following diagram gives rules for access ~~specifiers~~ ^{no modifiers}.

SP(Same Package)

S1 SBC(SP Base class)

Private int n₁=10; ✓
 — int n₂=20; ✓
 Protected int n₃=30; ✓
 Public int n₄=40; ✓

S2 SDC

n₁ X
 n₂ X
 n₃ X
 n₄ X

S3 SIND(SP independent class) ^{class-A}

SBC O1=new SBC();
 O1.n₁ X
 O1.n₂ ✓
 O1.n₃ ✓
 O1.n₄ ✓

OP(Other Package)

C4
 ODC(OP derived class)
 n₁ X
 n₂ X
 n₃ ✓
 n₄ ✓

OINDE(has-A)

SP.SBC O1=new O.SBC();
 O1.n₁ X
 O1.n₂ X
 O1.n₃ X
 O1.n₄ ✓

- NOTE:
- * Private AM is also known as native AM
 - * Default AM is also known as package AM
 - * Protected AM is also known as inherited AM
 - * Public AM is also known as universal AM.

Access specifier protection matrix :-

(Q24)

Category of category classes of access modifier protection	Same package BC	Same package DC	Same package INDC	Different other package DC	Different other package INDC
private	✓	X	X	X	X
default	✓	✓	✓	X	X
protected	✓	✓	✓	✓	X
public	✓	✓	✓	✓	✓

✓ : Accessible visible , X : Not accessible/invisible

Write a Java program which illustrate the rules of access specifiers modifiers.

|| SBC.java

Package SP;

public class SBC

{

 private int n1 = 10;

 int n2 = 20;

 protected int n3 = 30;

 public int n4 = 40;

 public SBC()

{

 System.out.println("Val of n1 = " + n1);

 System.out.println("Val of n2 = " + n2);

 System.out.println("Val of n3 = " + n3);

 System.out.println("Val of n4 = " + n4);

SP

→ SBC class

cmd>javac -d . sdc.java

SAC

Package SP;

Public class SDC extends SBC

{

 Public SDC

{

 SOP("val of n₁ = " + n₁);

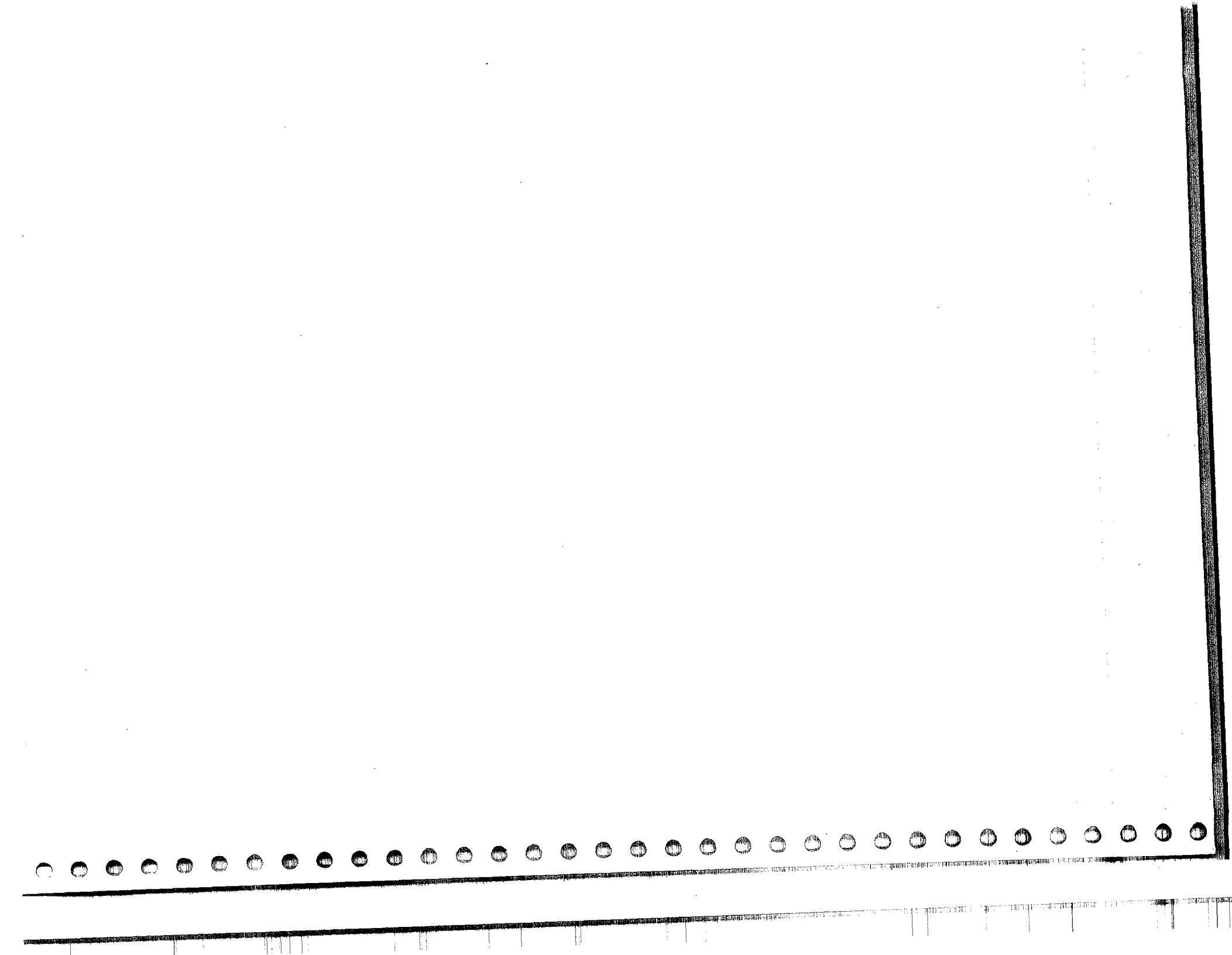
 SOP("val of n₂ = " + n₂);

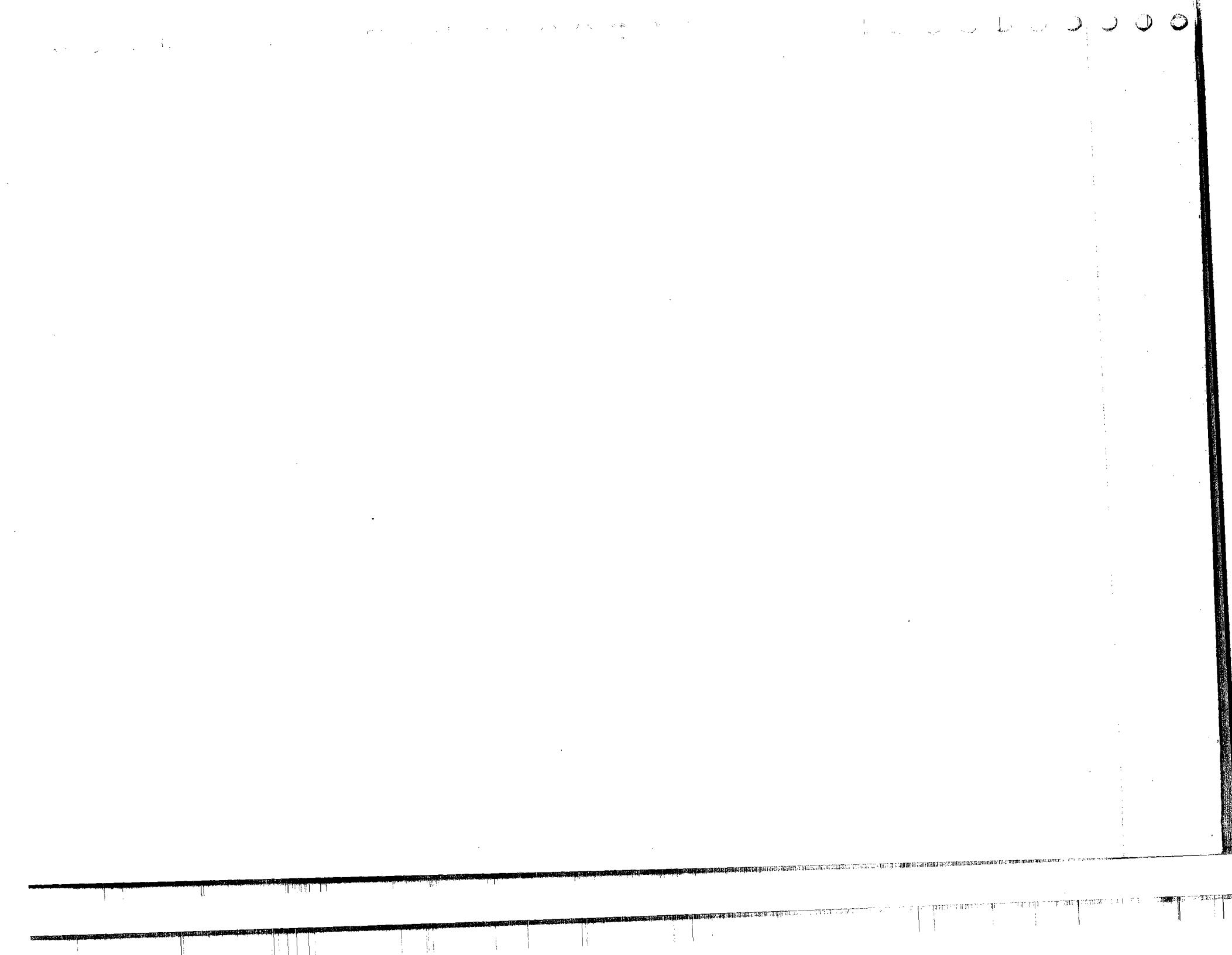
 SOP("val of n₃ = " + n₃);

 SOP("val of n₄ = " + n₄);

}

}





10/11/13 - 10,000 - 2/-

$$\begin{array}{r} 100-2 \\ 1000-20 \\ 10,000-200 \end{array} \quad \begin{array}{r} 200 \\ 19 \\ \hline 3800 \end{array} \quad - 13,800$$

13/2/14 - 10,000

$$\begin{array}{r} 200 \\ 16 \\ \hline 3200 \end{array} - 13,200$$

$$\begin{array}{r} 13,800 \\ 13,200 \\ \hline + \\ \hline 27,000 \end{array} \quad \begin{array}{r} 20,000 \\ 7,000 \\ \hline 27,000 \end{array}$$

3,800
27
27
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5
6
19
27
19
6

control Structure

① Branching stmt / conditional stmt / selection stmts

Ex:- if, if else, switch

② Looping stmt / Repetitive stmt / Iterative stmts

Ex:- while, do while

③ Miscellaneous stmts

Ex:- Break, continue, go to

10 - X - w 100 - C - w 1000 - M - w
9 - IX - if 90 - XC - if 500 - D - if
5 - V - if 50 - L - if 900 - CM - if
4 - IV - if 40 - XL - if 400 - CD - if
1 - I - w

1



Exception Handling

(Q26)

- The aim of exception handling is to build strong apps.
→ To develop any project (or) any app as the part of real world we use some programming language. If we write any program with certain type of language then we get 3 types of errors. They are 1. compile time errors 2. logical errors, and 3. run time errors.

Compile Time Errors :-

- These errors occurs during compilation phase due to syntaxes are not followed by the programmer
→ These errors solved by the programmers during development level.

Logical Errors :-

- These errors occurs during execution/run time becuz of misinterpretation/wrong representation of logic.
→ Logical errors always gives inconsistent/wrong results
→ Logical errors solved by the programmers at development level.

Runtime Errors :-

- These errors occurring during execution/run time
→ These errors are occurring due to invalid/wrong input entered by app user.
→ Run time errors solved by the programmers at development level by having forecasting knowledge (or) at implementation level.

* The languages like C, C++, COBOL etc & whose apps are treated as weak becuz these languages are not containing a facility called exception handling.

The languages like Java & .Net & whose apps are treated as Robust becoz these languages contains an effective facility called exception handling.

In general to any project/app which is developed with any language/technology & if the app user enters invalid input they are by default generates system/technical error messages which are not understandable by app users & understandable by only programmers. which is not a recommended process in SW development.

Hence, industry is highly recommended to build the strong apps by making use of exception handling & convert system error message into user friendly error message.

Points to be remembered :-

- When the app user enters invalid input, we get run time errors.
- Run time errors always generates system error messages.
- Run time errors of Java program are known as exception.
- Exception always generates system error message.
- When the exception occurs in the Java program, program execution is abnormally terminated, CPU control comes out of the program flow & JVM generates system error message.
- Def of Exception Handling:-

The process of converting system error messages into user friendly error messages is known as exception handling.

- Each & every task/operation/action must be performed wrt object in exception handling.

WKT whenever an exception occurs in the Java program, program execution is abnormally terminated, CPU control comes out of program flow & JVM generates system error message (SEM).

Generating SEM is considered as an operation, & it must be performed wrt an object & every object need a class & this class is called exception class.

The purpose of exception class is to terminate the program execution abnormally, JVM will create an object of exception class & generates SEM. As a Java programmer we use the same exception class & we generate user friendly error msg which is one of recommended process in SW development.

In general for every ^{common} problem (Invalid IP), there exist exception class.

Types of Exceptions

In Java programming we've 2 types of exceptions. They are

1. Pre defined/Built in exceptions
2. User / Programmer/ custom defined exceptions

Predefined exception developed by SUN MS developers, supplied as a part of Java SW & whose role is to deal with universal problems.

- Some of the universal problems are
- a, Division by zero problem (Arithmetic^{NoSpace} Exception)
 - b, Invalid number format problem (NumberFormatException)
 - c, Invalid bounds of the array (ArrayIndexOutOfBoundsException) etc

User defined exception developed by Java programmer,
supplied as a part of their Java project & whose role is
to deal with common problem.

Some of the common problems are

- a. Attempting to enter invalid PIN number in ATM based app's
- b. Attempting to enter negative salary for an employee.
- c. Attempting to enter wrong user name & password in authentication based app's.
- d. Attempting to deposit invalid amount
- e. Attempting to withdraw more amount than existing.

Types of pre defined exception:-

pre defined exceptions are classified into 2 types. They are

1. Asynchronous exceptions
2. Synchronous exceptions

Asynchronous exception:-

These exceptions deals with H/w problems & external problems.

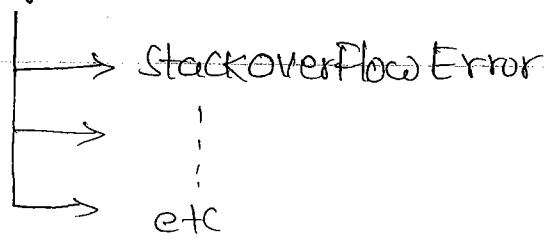
Ex:- mouse/ keyboard/ mother failed }
Memory problems } H/w problems

power failures — External problem.

At present SUN MS/ oracle corp developers did not develop complete API for develop dealing with Asynchronous exceptions (Partially developed).

For dealing with all asynchronous exceptions in Java for new feature we've a pre defined class called

Java.lang.Error



Synchronous exceptions :-

These exceptions deals with programmatic run time errors
Synchronous exceptions are classified into 2 types. They are

1. checked exception
2. un checked exception

Checked exception :-

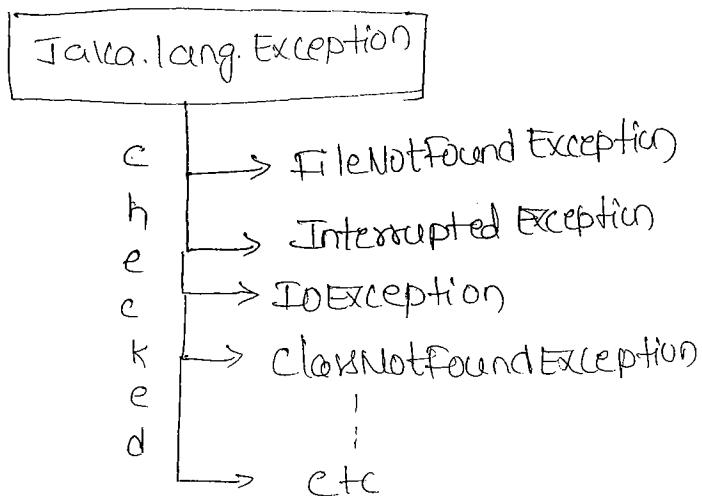
Def :- 1

checked exceptions are those which are the direct sub classes of Java.lang.Exception (or)

Def :- 2

The exception which are occurring at run time will be showing them as errors at compile time.

Ex :-

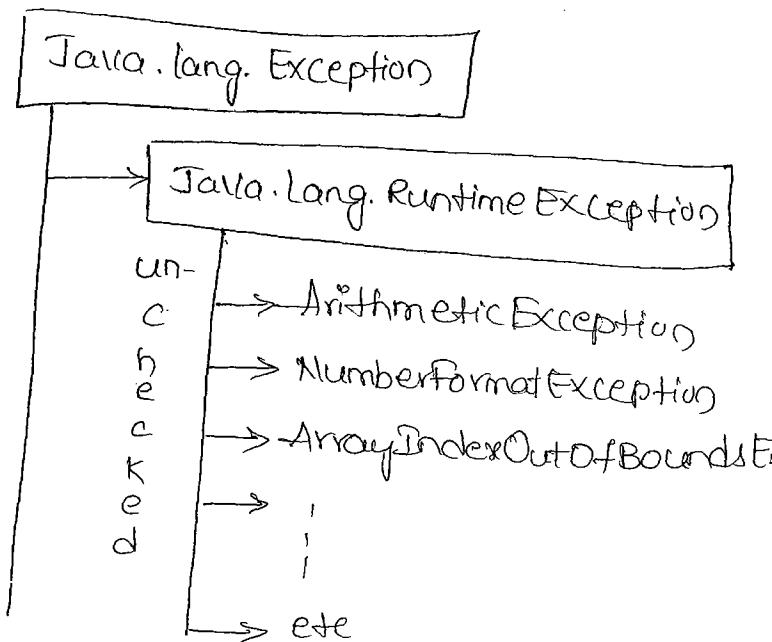


128

Unchecked exception :-

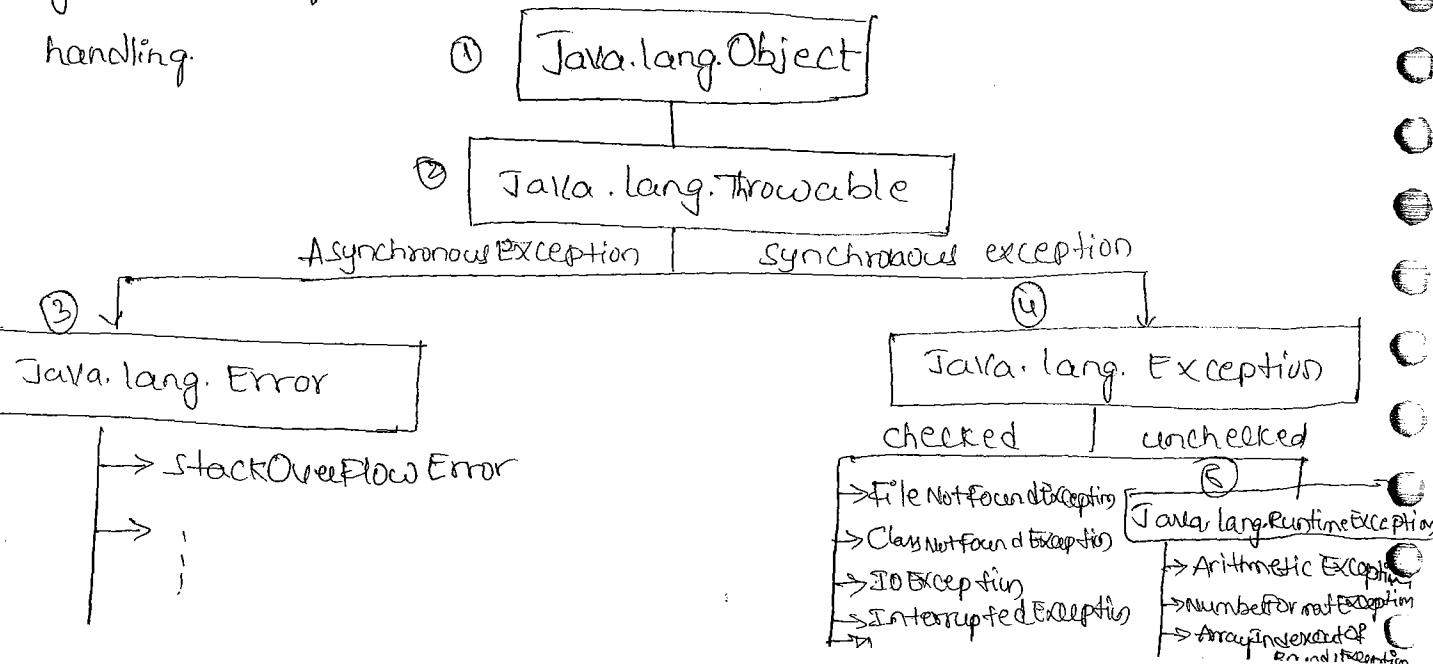
Def :- 1 un checked exceptions are those which are the direct sub classes of Java.lang.RuntimeException (or)

Def :- The exceptions which are occurring at run time will be showing them as errors at run time only but not at compile time.



Exception Handling Hierarchy Chart :-

Hierarchy Charts in Java programming makes us to understand how the features are inheriting from top most base class (TBC) to intermediate base class (IBC) & from IBC to bottom most derived class (BDC). The following diagram gives list of exception classes available in hierarchy of exception handling.



① Java.lang.Object is the super class for all the classes in Java.

It provides garbage collection facility for collecting unused memory space to improve the performance of Java based application.

② Java.lang.Throwable is one of the pre-defined super class for all the exception in Java. & it decides what type exception occurs in the Java program (either asynchronous or synchronous).

③ Java.lang.Error is the super class for all Asynchronous exceptions.

④ Java.lang.Exception is the super class for all Synchronous Checked exception.

⑤ Java.lang.RuntimeException is the super class for all synchronous unchecked exception.

Programmatically, even though there exist multiple exceptions in the Java program, at any point of time either JVM (or) Java programmer can generate & process only one exception but not multiple exceptions.

If an exception occurs in Java program JVM will create an object of exception sub class & generates system error message by default.

Technical Defn of exception :-

An exception is an object occurs at runtime which will describe nature of the message. The nature of the message can be either system error message (or) user friendly error message.

Ex:-

ArithmeticException ae = new ArithmeticException(" / by zero");

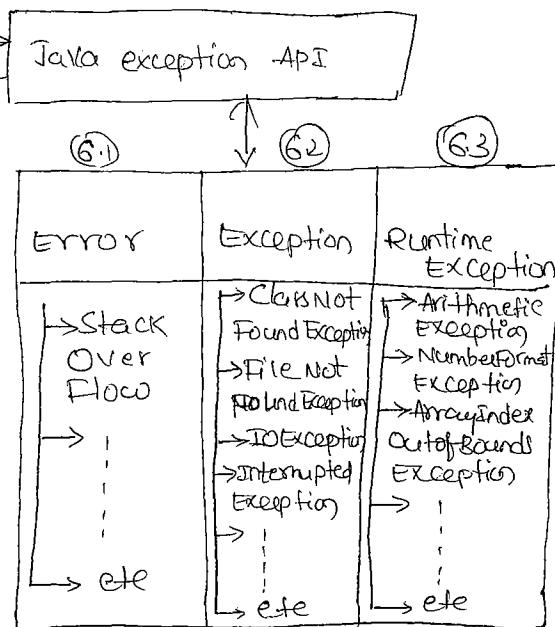
↓ ↑ ↓
Exception sub Object Run time

single parameterized constructor by taking string as a parameter

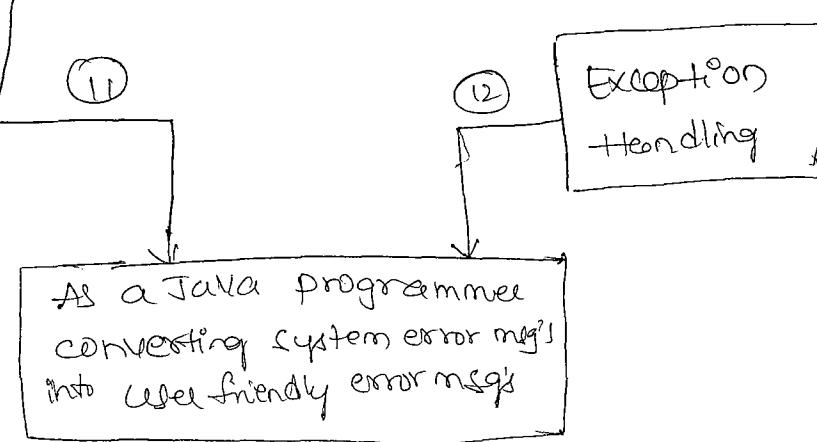
Internal flow of exception occurrence:

Whenever an exception occurs in the Java program it is mandatory to refer Java exception API to know internal flow of exception occurrence and it is given in the following diagram.

Java
Programmer



633



634

18/18

I. App user enters valid IP to the Java programmer

18/18

II. JVM can process the Java program with valid IP & gives valid op.

1. App user enters invalid IP to the Java programmer.

2. JVM can't process the Java program with invalid IP & contacts to JRE (JRE = JVM + Java-API)

3. JRE communicates with `Java.lang.Throwable` for finding what type of exception occurs in the Java program.

4. `Java.lang.Throwable` is one of pre-defined super class for all the exceptions in Java. & it decides what type of exception occurs in the Java program (either synchronous or asynchronous) & gives some msg back to JRE.

5. JRE communicates with Java exception API for obtaining exception sub class.

6. 1, 6.2, 6.3: Java exception API executes either ⑥.1 (`Java.lang.Error` for Asynchronous exception) or ⑥.2 (`Java.lang.Exception` for synchronous checked exception) or ⑥.3 (`Java.lang.RuntimeException` for synchronous unchecked exception).

7. Java exception API gives the exception sub class to JRE

8. JRE gives exception sub class to JVM.

*9. JVM will create an object of exception sub class

Ex:- For division of 2 numbers program if we enter 10 & 0 as an I/P then JVM will create an object of `ArithmenticException`. Programmatic

-ally, `ArithmenticException ae = new ArithmenticException("1 by zero");`

10. JVM will generate system error message after creating an object of exception sub class.

Ex:- The system error msg for the exception which occurred in the Ex of

exception in thread main -----

Java.lang.ArithmeticException : / by zero -----

It is not recommended to generate system error msg's in real world application & highly recommended to generate user friendly error msg's.

Ex 12: As a Java programmer we will convert the system error msg's into user friendly error msg's by making use of exception handling.

Ex: The user friendly error msg for the system error msg in the Ex of step no:-10 is shown below

U.F.E.M

Don't enter zero for denominator -----

Handling the exception

→ Handling the exception are nothing but converting system error messages into user friendly error messages.

→ For handling the exception we've 5 keywords. They are

1. try
2. catch
3. finally
4. throws
5. throw

Syntax for handling the exception

586

Syntax:-

try
{

Block of Stmt(s) - which are
causing problems at runtime

} catch (Type of exception1 obj1)

{

Block of Stmt(s) - which
provides user friendly error msg's

}

catch (Type of exception2 obj2)

{

Block of Stmt(s) - which provides
user friendly error msg's

}

:

catch (Type of exception-n obj-n)

{

Block of Stmt(s) - which provides
user friendly error msg's

}

finally

{

Block of Stmt(s) - which will
execute compulsorily

}

try Block:-

(25)

- It is the block in which we write the block of statements which are causing problems at run time. In other words the problematic statements which are generating exceptions at runtime must be written in try block & it is called "exception monitoring block."
- If any exception occurs in try block then JVM control comes out of try block & executes appropriate catch block.
- After executing appropriate catch block, JVM control never goes to try block even we use return statement in the catch block.
- Each & every try block must be immediately followed by catch block. i.e., we should not write any intermediate statements btw try & catch blocks
- Each & every try block requires atleast one catch block otherwise we get compile time error (It is required to write more no. of catch blocks for generating multiple user friendly error messages to make the app! strong)
^{If}
- In some of the circumstances one try block can contain another try block i.e., nested/Inner try blocks can be permitted.

catch block :-

- It is the block in which we write the block of statements which will provide user friendly error messages. In other words this block suppresses system error messages & generates user friendly error messages & this block is called 'exception' handler block".
- catch block will execute when an exception occurs in try block
- Even though there exist multiple catch blocks, JVM can execute an appropriate catch block depends on type of exception occurred
→ It is the work.

- * In the catch block as a Java program we declare an object of exception sub class & internally, exception sub class object referenced by JVM.

Ex:-

```
try
```

```
{
```

```
=
```

```
int c=10/0;
```

```
=
```

```
}
```

catch (ArithmaticException ae)
 Declaration of exception
 sub class written by

}

Java programmer

Internally,

ArithmaticException ae = new ArithmaticException ("1 by zero");
 Reference of exception sub class done by JVM.

- In some of the circumstances in the catch block one can also write try & catch blocks.

finally block :-

- It is the block in which we write the block of statements which will relinquish (release) terminated / close the resources (files & database) which are obtained in try block.

→ finally block will execute compulsorily.

→ Writing finally block is optional.

→ If at all we write finally block, it should be written after catch block (if catch block present) (or) after try block

→ In some of the circumstances in the finally block one can write try & catch blocks.

→ It is highly recommended to the Java programmer to write one finally block per Java program to relinquish the resources. (289)

* Write a Java program which illustrate try block catch block & finally block.

// DIV2.java

```
class DIV2
{
    public static void main(String [] args)
    {
        try
        {
            String s1 = args[0];
            String s2 = args[1];
            int x = Integer.parseInt(s1);
            int y = Integer.parseInt(s2);
            int z = x / y;
            System.out.println("division in DIV2 = " + z);
        } catch (ArithmaticException ae)
        {
            System.out.println("don't enter zero for den--");
        }
        catch (NumberFormatException nfe)
        {
            System.out.println("don't enter alpha-numeric values");
        }
        catch (ArrayIndexOutOfBoundsException ab)
        {
            System.out.println("enter two values");
        }
    }
}
```

`finally`

`SOP(" am from finally block");`

}

`} // main()`

`if Div2`

Case :- 1 If exception occurs then

- * A part of try block will execute
- * An appropriate catch block will execute
- * A finally block will execute (If we write)

Case :- 2 if (exception doesn't occurs) then

- * A complete try block will execute
- * A finally block will execute (If we write)

Q:-1 Determine the o/p of the following program.

`// Exam1.java`

`class Exam1`

```
{ public static void main(String args)
```

`try`

```
{ SOP("Java");
```

`int x = 100/0; // exception stmt`

`SOP(" val of x = " + x);`

}

`finally`

`SOP(" am from finally");`

Output:-

Q41

Java

"I am from finally"

Java.Lang.ArithmaticException : / by zero

Explanation :-

If any Java program contains try block & finally block only if an exception occurs in try block then JVM will execute the following.

- A, The stmts appears before exception Stmt.
- B, Stmt written in finally block
- C, exception related messages.

Q42 Determine the o/p of the following program.

//Exam2.java

class Exam2

{

 public static void main (String [] args)

{

 try

 {

 Sop ("Java");

 int x = 100/0;

 Sop (" val of x = " + x);

 }

 finally

 {

 Sop (" I am from finally ");

 }

 Sop (" Sathya ");

 Sop (" hyd ");

}

Output:

842

Java

i am from finally

Java.Lang.ArithmetricException : \ by zero

Explanation

If any Java program contains try & finally blocks only & Stmt followed after finally block & if an exception occurs in try block then JVM will execute the following

- a. Stmt appears before exception Stmt
- b. Stmt written in finally block
- c. Exception related messages but JVM will never execute the Stmt appears after finally block.

Q.3 Determine the O/P of the following program.

//Exam3.java

class Exam3

{

 public static void main(String [] args)

{

 try

 {

 System.out.println("Java");

 int x = 100/0; // exception statement

 System.out.println("val of x = " + x);

 } catch (ArithmetricException ae)

{

 System.err.println("don't enter zero for den...");

}

 System.out.println("Hello1");

 System.out.println("Hello2");

} // main()

} // Exam3

Output :-

(243)

Java

Don't enter zero for den. ~

hello1

hello2

Explanation :-

If any Java program contains a try block, catch block & the block of stmts after the catch block ~~then~~ and defined if an exception occurs in the Java program then JVM will execute the following (as the stmts appears before the exception stmt).

(a) stmts appears in catch block

(c) stmts appears after catch block.

NOTE :- If any Java program contains try block, catch block & block of statements after catch block and if an exception occurs in Java program & not matching with catch block then JVM will execute the following.

(a) statements appears before exception statement

(b) exception related message

(c) But not executing the statements appears after catch block.

* Decide the output of following program.

/* Exam5.java

class Exam5

{

 public static void main(String [] args)

{

 for (int i = 0; i < 10; i++)

```

    SOP("Java");
    int x=100/0;
    SOP("val of x = "+x);
}
} catch(ArithmeticException ae)
{
    System.err.println("don't enter zero for den.--");
}
finally
{
    SOP("I am from finally");
}
SOP("Hello1");
SOP("Hello2");
}
}

```

Output:-

Java
 don't enter zero for denominator
 I am from finally
 Hello1
 Hello2

Explanation :-

If any Java program contains try block, catch block, finally block & stmts appears after finally block & if an exception occurs in the Java program then JVM will execute the following.

- The statements executed before exception statement
- Statements appears in appropriate catch block
- The statements written in finally block
- The statements appear after finally block

Note: We should not write consecutive multiple finally blocks. & also we should not write consecutive try blocks.

THROWS

In the context of exception handling we've 2 types of methods. They are

1. Specific method
2. Common method

- With specific methods we always fulfill specific requirements.
- With common methods we always fulfill common requirements.
- If any exception occurs in specific method then it is highly recommended to the programmer to write try & catch blocks for handling the exception. But one is not recommended to write "throws" keyword.
- If any exception occurs in common method then such exceptions should not be handled but it must be always send always the exception to specific method by using "throws" keyword.

Defn purpose-1 of throws :-

"throws" is a keyword which will describe/ express the exception which are occurring in common method.

Defn purpose-2 :-
"throws" is a keyword which gives an indication to the specific method to place common exception method under try & catch block. for generating user friendly error messages in our method.

- The place of using "throws" keyword is always as Q46 a part of common method heading
- If a common method heading contains "throws" keyword then it is called "common exception method". otherwise it is called as "common normal method".

Rules of throws Keyword :-

Rule:-1

If "throws" keyword is throwing checked exception then it is mandatory to the programmer to place common exception under try & catch block. otherwise we get compile time error.

Rule:-2

If "throws" keyword is throwing unchecked exception then it is optional to the programmer to place the common exception under try & catch block.

Rule:-3

Irrespective of ~~the~~ type of exception "throws" keyword is throwing then industry is highly recommended to the programmer to place the common exception method under try & catch block. for generating user friendly error messages.

18/8 Write a Java program which illustrate "throws" keyword which is used as a part of pre defined method

consider the following statement

Java.lang.Integer

↓
public static int parseInt(String) throws NumberFormatException

Here parseInt method is one of the common exception
method & it must be placed always with in try & catch
block for generating user friendly error messages

```
import java.util.Scanner;  
class SathyaPrgrm  
{  
    public static void main(String [] args)  
    {  
        Scanner s=new Scanner(System.in);  
        System.out.println("Enter the marks");  
        String marks=s.nextLine();  
        try  
        {  
            int im=Integer.parseInt(marks); // common exception method  
            System.out.println("Marks = "+im);  
        } catch (NumberFormatException nfe)  
        {  
            System.out.println("don't enter Alpha-numeric values for marks");  
        }  
        finally  
        {  
            System.out.println("I am from finally block");  
        }  
    }  
}
```

* Write a Java program which illustrate the concept of "throw" which is used as a part of user defined method.

1) Sathya.java

Package SP;

Public class Sathya

{

 Public void division(String s1, String s2) throws

 ArithmaticException, NumberFormatException

{

 Int a = Integer.parseInt(s1);

 Int b = Integer.parseInt(s2);

 Int c = a/b;

 Sop(" div in Sathya = " + c);

}

} // Sathya

Compile the above program

javac -d . Sathya.java

[SP]

↳ Sathya.class

In SP.Sathya class the division method is one of the user defined common instance exception method & it must be always written within try & catch block for generating user friendly error messages.

* Write a java ^{main} program which makes use of division method of SP.Sathya class

1/Sathyaprogs.java

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```
import java.util.Scanner;
import SP.Sathyas;
class Sathyaprogs
{
    public static void main(String []args)
    {
        Scanner s = new Scanner(System.in);
        System.out.println("Enter First Value");
        String s1 = s.nextLine();
        System.out.println("Enter Second Value");
        String s2 = s.nextLine();
        Sathyas so = new Sathyas();
        try
        {
            so.Sathyas(s1, s2); // user defined common instance
            exception method.
        } catch (ArithmaticException ae)
        {
            System.out.println("don't enter zero for denominator");
        }
        catch (NumberFormatException nfe)
        {
            System.out.println("don't enter alphanumeric values for division");
        }
        finally
        {
            System.out.println("I am from finally block");
        }
    }
}
```

re-throwing / deep throwing the exception:-

(250)

Def: First method is throwing the exception to 2nd method. 2nd method is throwing 1st method related exception to 3rd method. w.r.t 2nd method 1st method related exception is called re-throwing the exception.

Ex:- In SathyaProg.java, Sathya.java (See previous pages), the parseInt (-) (1st method) of integer class is throwing NumberFormatException to division (-, -) (2nd method). division (-, -) of Sathya class is again throwing NumberFormatException of parseInt (-) to main () (3rd method). With respect division-
NumberFormatException of parseInt (-, -) is called re-throwing the exception.

NOTE:-

→ out & err are the two objects of PrintStream class and they are created as static data member in another predefined class called system. The purpose of out object is to display soft outputs of java program. whereas the purpose of err object is that to display abnormal terminated messages which are occurring as a part of exception.
→ in is an object of InputStream created as a static data member in another pre defined class called system. The purpose of in object is that to provide an environment to read the data from keyword.

Finding the details about unknown exception :-

When we write a Java program there is a possibility of many no. of exceptions & Java programmer may not be knowing details about all the exceptions & at that point of time we are unable to generate user friendly error messages.

In Java programming to find the details about unknown exceptions, we have 3 approaches they are

1. By using an object of `java.lang.Throwable/java.lang.Exception`
2. By using `PrintStackTrace()`
3. By using `getMessage()`

By using an object of `java.lang.Throwable/java.lang.Exception`:

By using the concept of dynamic binding, an object of `java.lang.Throwable` or `java.lang.Exception` we can get two details related to unknown exception

- a. Name of the unknown exception
- b. Nature of the message

~~Ex :-~~

```
try  
{
```

```
=
```

```
int c = 10/0;
```

```
=
```

```
} catch (Throwable t)
```

```
Exception
```

```
{
```

```
System.out.println(t); // Java.lang.ArithmeticException : / by zero
```

ArithmeticException (" / by zero")
Referenced by JVM

Nature of

→ By using PrintStackTrace() :-

(252)

→ It is one of the pre-defined method present in `java.lang.Throwable` and further inherited into `java.lang.Exception` & `java.lang.Error`.

→ By using `PrintStackTrace()` we can get three details

a) Name of the unknown exception

b) Nature of the message

c) Line number where the exception occurs

The prototype of the `PrintStackTrace()` is shown below

`Java.lang.Throwable` ↴

`public void PrintStackTrace();`

Since the return type of `PrintStackTrace()` is `void` we can't call this method as a part of either `System.out.println()` or

`System.out.println(e.printStackTrace()); // Invalid`

`e.printStackTrace(); // Valid`

Ex :-

`// X.java`

```
try
{
    i = 10/0;
    e =
}
```

```
} catch( Exception e)
```

```
{
```

```
    e.printStackTrace(); // Java.lang.ArithmeticException: by zero at X.java: 3
```

```
}
```

Name of the
unknown exception

Nature of
message

Line Number

ArithmeticException("by zero");

new

By using getMessage():

(25)

It is one of the pre-defined method present in `java.lang.Throwable` and inherited into `java.lang.Exception` and `java.lang.Error`.

This method gives only nature of the message but not other details.

The prototype of `getMessage()` is shown below

`Java.lang.Throwable` ↴

`public String getMessage();`

EX:-

```
try
{
    int x=Integer.parseInt("10");
} catch (Exception e)
{
    System.out.println(e.getMessage()); // For InputString : 10x
}
Nature of
message
```

NOTE:-1

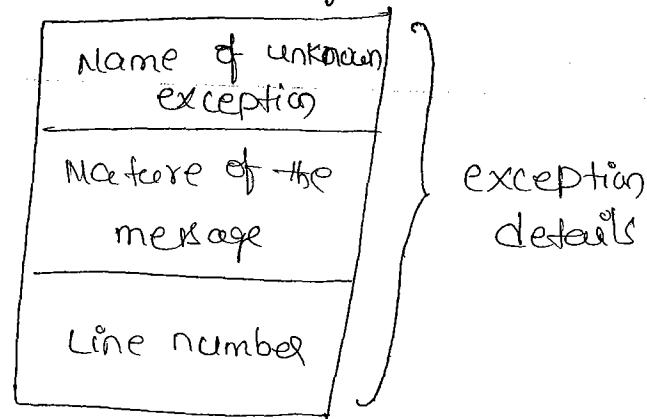
In Java programming if any method is returning a value then holding that value is a variable of that return type is optional.

NOTE:-2

If any exception occurs in the Java program, then exception details will be pushed into the stack memory. Name of exception, nature of msg & line no.

Stack memory

(25p)



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throw

"throw" is a keyword which is used for carrying the created exception from method body & hand over to "throws" keyword

(or)

"throw" is a keyword used for hitting/generating/raising the exception which is occurred as a part of method body.

The place of using "throw" keyword is always as a part of method body.

Rules for using "throw" Keyword :-

Rule :- 1 When "throw" keyword is hitting checked exception then it is mandatory to write "throws" keyword as a part of method heading. Otherwise we get compile time error

Rule :- 2 When "throw" keyword is hitting unchecked exception then it is optional to write "throws" keyword as a part of method heading.

Rule :- 3 Irrespective of type of exception we hit with "throw" keyword then it is highly recommended to write "throws" keyword as a part of method heading.

SYNTAX-1

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```
<classname><obj> = new <classname>(msg);  
    throw (obj);  
    (or)  
    throw(new <classname>(msg));
```

Here, classname represents name of exception sub class.

SYNTAX-2 ("throw" keyword along with "throws" keyword)

Rettype method Name (List of formal
Params if any) throws <classname-1> ...
 <classname-n>

{

if (test cond1)

{

```
<classname-1><obj-1> = new <classname-1>(msg);  
    throw (obj-1);
```

}

:

if (test cond-n)

{

```
    throw(new <classname-n>(msg));
```

}

}

In the above syntax <classname-1> ... <classname-n> represents
name of the exception subclasses.

* Write a java program which will recreate an object of
④ ArithmeticException & generate our own message.

1) SathyaTech.java

Package st;

Public class SathyaTech

{

Public void div(int a, int b) throws ArithmeticException

{

if (b==0)

{

ArithmeticException ae = new ArithmeticException("don't
enter zero for denominator");

throw ae;

}

else

{

int c=a/b;

SOP C " div in SathyaTech = "+c;

} else

} if div

} if Sathya Tech

compile above program

javac -d . SathyaTech.java

st

↳ SathyaTech.class

In st. SathyaTech class the div() is one of the user defined common
exception instance method. & it must be placed with in try & catch block.

* Write a java main program which makes use of div() of 257

St.Sathyatech class

//ExceDemo.java

import java.util.Scanner;

import St.Sathyatech;

class ExceDemo

{

 Public static void main(String [] args)

{

 Scanner s = new Scanner (System.in);

 SOP("Enter first value");

 int x = s.nextInt();

 SOP("Enter second value");

 int y = s.nextInt();

 St.Sathyatech st = new Sathyatech();

 try

 {

 st.div(x,y);

 } catch (Exception e)

 {

 System.out.println(e); //java.lang.ArithmeticException : don't
 enter zero for denominator

 }

 finally

 {

 System.out.println(" finally block");

 }

} // main

} // Sathyatech

Differences btw throw & throws

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throw

→ "throw" is a keyword used for hitting or generating the exception which is occurring as a part of method body.

→ The place of using "throw" keyword is always as a part of method body.

→ When we use "throw" keyword as a part of method body for hitting any type of exception it is highly recommended to write "throws" keyword as a part of method heading.

throws

→ "throws" is a keyword which is used for giving an indication to the specific method to place the common exception method within the try & catch block for generating user friendly error message.

→ The place of using "throws" keyword is always as a part of method heading.

→ When we write "throws" keyword as a part of method heading it is optional to write "throw" keyword as a part of method body (In the write "throws" keyword as a part case of re-throwing the exception).

Development of user/programmer defined exception:-

User defined exceptions developed by Java programmers available as a part of Java project & whose role is to deal with common problems.

Some of the common problems are

1. Attempting to enter invalid salary to an employee.

2. Attempting to enter wrong PIN number in ATM based apps.

3. Attempting to enter invalid user name & password etc

What are all the guidelines followed by SUN/MJ developers at the time of developing pre-defined exception classes, same guidelines will be followed by Java programmers for developing user defined exception classes.

Steps/ guidelines for developing user defined exceptions:-

1. Choose an appropriate package for placing user defined exception sub classes for common access & ensure that the package stmt must be first executable stmt.
2. Choose an appropriate user defined class & ensure that where modified must be public.
3. Whatever the class is selected in step②, it must extends either `java.lang.Exception` or `java.lang.RuntimeException` for inheriting the capabilities of exception handling to terminate the program execution abnormally when the app user enters invalid input. Hence, Step② class is called user defined exception sub class.
4. Each & every user defined exception sub class must contain a Parameterized constructor by taking String as a parameter. Here String parameter represents nature of the message.
5. Each & every user defined exception sub class Parameterized constructor must call the parameterized constructor of either `java.lang.Exception` or `java.lang.RuntimeException` by making use of Super(msg)
Here msg is the string parameter describes nature of message (the reason of writing msg is that if any specific exception occurs in the java program & it is not handled by the Java program then specific exception will be posted to either `java.lang.Exception` or `java.lang.RuntimeException`)
6. Whatever the exception sub class we are placing in the package, it must be given as a file name with an extension .java.

Q 8.18
* Develop a user defined sub class for dealing with -ve salary
of an employee

// NSalException.java ----- (6)

Package Sathya.lang; // --- (1)

Public class NSalException extends Exception
{

 Public NSalException (String s) // --- (4)

{

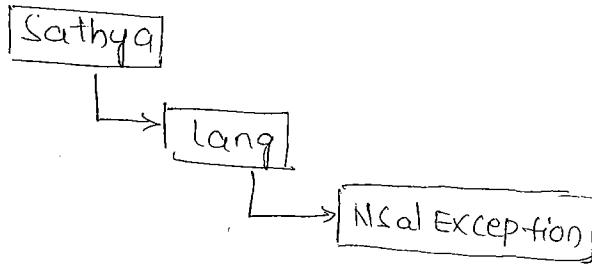
 Super(); // --- (5)

}

} // NSalException - development of user defined exception sub class

compile the above program

javac -d . NSalException.java



* Develop a user-defined sub class to deal with the salary
of an employee

// PSalException.java

Package Sathya.lang;

Public class PSalException extends RuntimeException

{

 Public PSalException (String s)

{

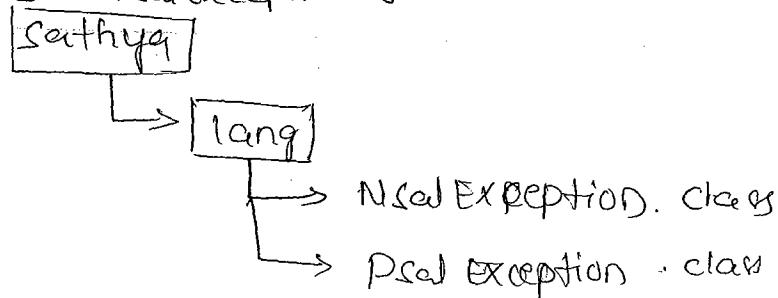
 Super();

}

} // PSalException

Compile the above program

javac -d . PsalException.java



No. of phases required for development of user defined exception

Phase-1:- Development of user-defined exception sub classes

Phase-2:- Development of user-defined common/general classes

Phase-3:- Development of user-defined specific classes

Development of user-defined exception sub class :- (P-1)

To develop phase-1 we need to follow 6 guidelines
(See previous pages)

Ex:- NsalException.java } are comes under user defined
PsalException.java } exception sub classes (See previous pages)

Development of user-defined common/general classes:- (P-2)

The purpose of P-2 classes development is that to deal with common requirements of all the programmes. By making use of pre-defined exception sub classes & user-defined exception sub classes for generating appropriate exception.

* Write a java program which will check the salary of any employee & generate appropriate exception.

1) Emp.java

package org.igate;

import Sathya.lang.NsalException;

import Sathya.lang.PsalException;

(262)

```

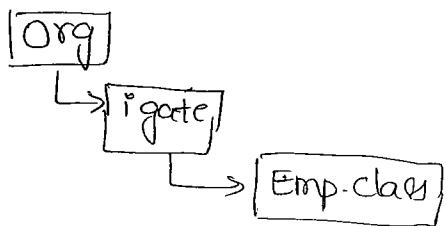
public class Emp {
    public void checkSal(String s) throws NSalException,
        PSalException, NumberFormatException {
        int sal = Integer.parseInt(s);
        if (sal <= 0)
            {
                NSalException no = new NSalException ("Invalid Sal");
                throw no;
            }
        else
            {
                PSalException po = new PSalException ("Valid Sal");
                throw po;
            }
    } // else
} // checkSal()

```

\exists || Emp -- dev of user defined common class.

compile the above program

javac -d . Emp.java



In org.igate.Emp class, checkSal is one of the user defined common exception Instance method & it must be placed always with in try & catch block.

Development of user defined specific class (P-3)

This phase classes deals with specific requirements of individual programmers. This phase classes handles common classes (P-2) & handles the exceptions.

* Write a java program which will check the salary of Sathya employee.

1) SathyaEmp.java

```
import org.igate.Emp;
import Sathya.lang.NsalException;
import Sathya.lang.PsalException;
import static java.lang.System.*;
import java.util.Scanner;
class SathyaEmp
{
    public static void main(String [] args)
    {
        Scanner s = new Scanner(in);
        out.println("Enter UR Sal");
        String sal = s.nextLine();
        Emp eo = new EMP();
        try
        {
            eo.checkSal(sal);
        } catch(NsalException n)
        {
            err.println("don't enter -ve/zero sal for emp");
        }
    }
}
```

catch (FileNotFoundException)

{

 err.println("Good Sal, try for best");

}

- catch (NumberFormatException)

{

 err.println("don't enter Alphanumeric Sal for emp");

}

----- → catch (Exception e)

finally

{

 err.println(e)

{

 System.out.println("I am from finally");

}

} // main()

} // CatchyEmp --- dev of user-defined specific class

NOTE:- When we write multiple catch blocks in the Java program then it is mandatory to the Java program to write specific catch blocks first & later general catch block (java.lang.Exception) otherwise we get compile time error.

* Write a user-defined exception based app for ^{user} authentication process (Verify the user name & password)

// InvalidLoginException.java

Package ivp.lang;

login

Public class Invalid^{login}Exception extends Exception

{

 Public Invalid^{login}Exception (String s)

{

 Super(s);

}

}

// ValidLoginException.java

(265)

Package up.lang;

Public class ValidLoginException extends RuntimeException

{

Public ValidLoginException (String s)

{

super(s);

}

}

Comp:- javac -d . ValidLoginException.java

// Login.java

Package org.wipro;

Import InvalidLoginException up.lang.InvalidLoginException;

Import ValidLoginException up.lang.ValidLoginException;

Public class Login

{

Public void Auth (String un, String Pwd) throws

InvalidLoginException, ValidLoginException

{

String s =

if (un.equalsIgnoreCase("Satyajit")) && (Pwd.equalsIgnoreCase("Java"))

{

ValidLoginException vo = new ValidLoginException (Valid
un, Pwd)

}

throw vo;

else

{

System.out.println ("Unauthorised User");

... ... throw InvalidLoginException ("Unauthorised user, un, Pwd);

11 Sathyauuser.java

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```
import org.wipn.Login;
import java.util.Scanner;
import java.lang.InvalidLoginException;
import java.lang.InvalidLoginException;
class Sathyauuser
{
    public static void main(String [] args)
    {
        Scanner s = new Scanner(System.in);
        System.out.println("Enter user name");
        String un = s.nextLine();
        System.out.println("Enter password");
        String pwd = s.nextLine();
        Login lo = new Login();
        try
        {
            lo.Auth(un, pwd);
        } catch(ValidloginException)
        {
            System.out.println("un & pwd is correct, proceed");
        }
        catch(InvalidLoginException)
        {
            System.out.println("un & pwd is wrong, try again");
        }
        catch(Exception e)
        {
            System.out.println(e);
        }
    }
}
```

Develop an exception based app in such a way that names of the people / Product names should not contain digits. (267)

Hint:- Sathya4Tech - Invalid - becoz it contains digits

SathyTech - Valid - becoz no digits

P-1 :- NameFormatException

P-2 :- org.tcs.ValidateName

public void checkName (~~String s~~ String s)

II NameFormatException.java

package np;

public class NameFormatException extends Exception

{

public NameFormatException (String s)

{

super(s);

}

} II NameFormatException - UDFSC

cmd:- javac -d NameFormatException.java

II ValidateName.java

package org.tcs;

import np.NameFormatException;

public class ValidateName

{

public void checkName (String s) throws NameFormatException

{

D - P100.

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```

char ch[] = s.toCharArray();
for (int i=0; i<ch.length; i++)
{
    if (Character.isDigit(ch[i]))
    {
        found = true;
        break;
    }
}
if (found)
{
    throw(new NameFormatException ("Invalid Name"));
}
else
{
    sop("UR Name is Valid");
}
}

```

3) // checkName()

3) // validateName - oev of UDCC

cmd: javac -d . ValidateName.java

// CheckNameDemo.java

```

import java.util.Scanner;
import np.NameFormatException;
import org.tcs.ValidateName;
class CheckNameDemo
{
    Scanner s = new Scanner (System.in);
    sop ("Enter UR Name");
    s.nextLine();
}

```

ValidateName vo = new ValidateName();

try

{

vo.checkName(name);

} catch (NameFormat Exception)

{

System.out.println("UR Name Should not contain digits");

}

catch (Exception e)

{

System.out.println(e);

}

finally

{

System.out.println("I am from finally block");

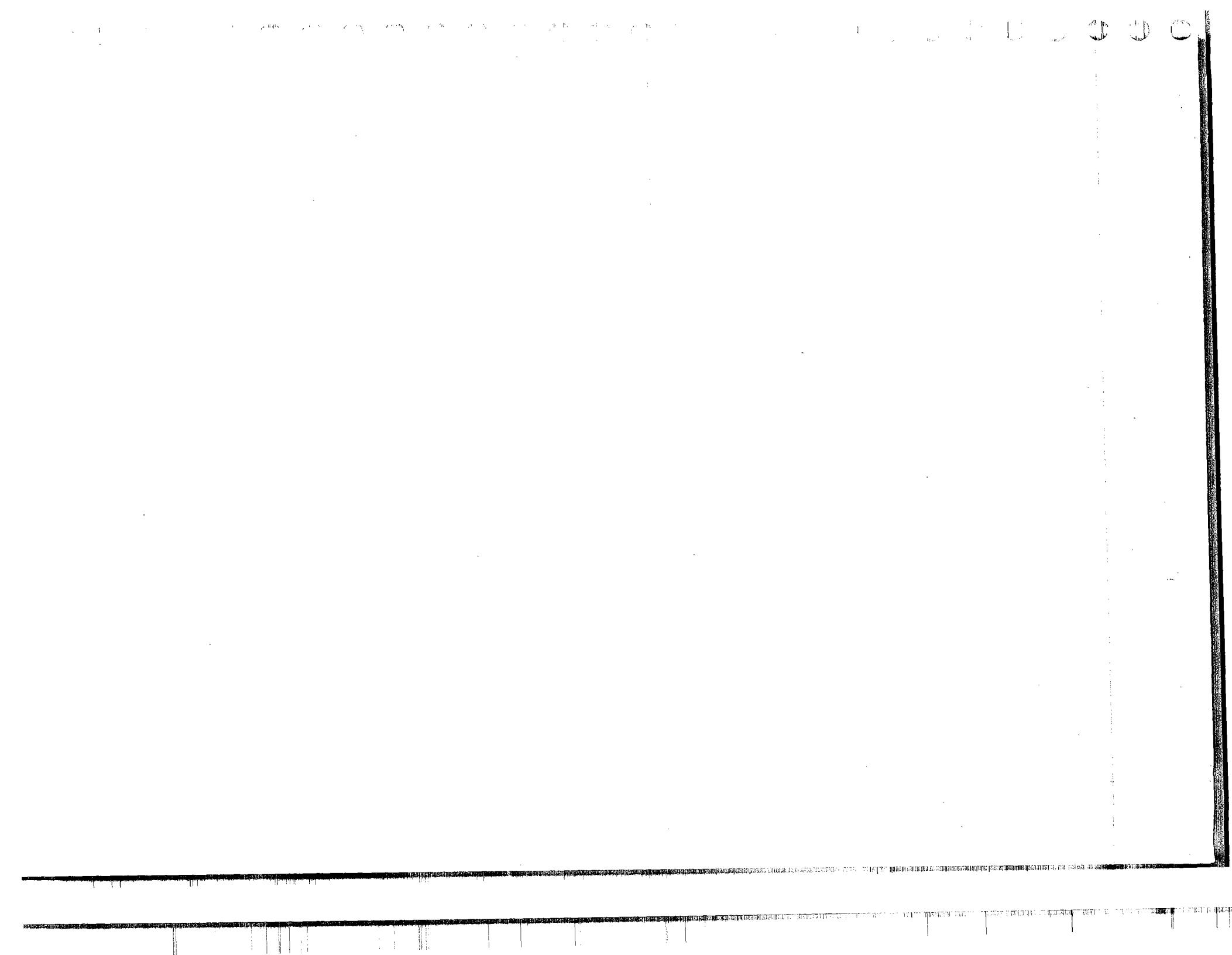
}

} //main()

} //CheckNameDemo

* Write a exception based class which will work like Sathya
ArithmaticException.

* Develop a exception based class which works like Sathya
NumberFormatException



24/8/15

Multi Threading

(240)

The purpose/aim of multi-threading is that to get/provide concurrent execution [simultaneously/parallelly executing multiple operations].

Defn of thread:- A flow of control is known as 'thread'.

→ The purpose of creating a thread is that "to execute logic of the Java program which is written in the form of user defined methods concurrently".

→ If a Java program contains multiple threads then it is called "Multi-threaded".

→ The languages like C, C++ are called single threaded modeling language becoz their execution environment contains single flow of control provides sequential execution, takes more execution time & doesn't contain any library for development of multi-threading apps.

→ A language like Java is treated as multi-threaded modeling language becoz their whole execution environment provides multiple threads, provides concurrent execution, take less execution time & contains an effective API for development of multi-threaded applications.

→ Whenever we write a Java program we get 2 types of threads
(a) Foreground/ Child thread
(b) Background/ Parent thread

→ A Foreground thread always executes logic of the Java program which is written in the form of methods.

→ A Background thread always monitors the execution started of

By default there exist single FGT & Single BGT. Programmatically we can have multiple FGT's & recommended to have one BGT.

→ The real time implementation of multi threading is that to develop real world server software (comcast, tomcat-Apache, weblogic-BEA system, websphere-IBM etc) In other words most of the server SW's developed by Server SW Vendors in Java language with multi threading concept.

→ To develop multi threading apps in Java we use the following

API

a. `java.lang.Thread` (class)

b. `java.lang.Runnable` (interface)

Hence, multi threading concept of Java is one of the specialized form of multi tasking of OS.

Q: How do you justify "Each & every Java program is multi threaded?"

Ans: When we execute the Java program, logic of the Java program is executed by one of the thread known as "Foreground thread".

To monitor the execution & status of FGT internally one more thread is created & it is known as "Background thread".

Hence, Java program contains 2 threads by default & it is multi threaded.

Q: What are the differences btw Program & Process.

Ans

Program

→ Set of optimized instructions is known as Program. → Process is under execution of program.

→ Program resides in secondary memo → Process resides in main memory for a long time until we delete or limited span of time.

→ A program is considered as a static object

→ A process is considered as a dynamic object

Process

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Process Based Vs Thread Based applications (Q)

27/2

0

Non-Multi Tasking Vs Multi Tasking application :-

0

→ In real world we develop 2 types of application. They are

0

1. Process based application (PBA)

0

2. Thread based application (TBA)

0

PBA

→ PBA provides/contains single flow of control.

→ TBA contains/provides multiple flow of controls.

0

→ Single threaded modeling languages related apps comes under PBA
Ex:- C, C++, COBAL, PASCAL etc

→ Multi threaded modeling languages comes under TBA.
Ex:- JAVA & .Net.

0

→ In PBA, context switch is more, → In TBA, context switch is less.

0

→ In PBA, for each & every sub-program there exist a separate address space.

→ In TBA, irrespective of no. of sub programs, there exist single address space.

0

→ PBA takes more execution time.

→ TBA takes less execution time.

0

→ PBA are treated as heavy weight components

→ TBA are treated as light weight components.

0

→ PBA provides only sequential execution but not concurrent execution

→ TBA provides both sequential & concurrent execution.

0

Definitions:-

Address space:- It is an amount of temporary memory space created by OS on the stack memory for the temporary execution of the method.

0

Context switch:- The mechanism of switching the control of CPU from one address space to another address space is called context switch.

0

→ For in host mode development context switch must be less.

0

components takes less execution time.

Q13

Short Notes:

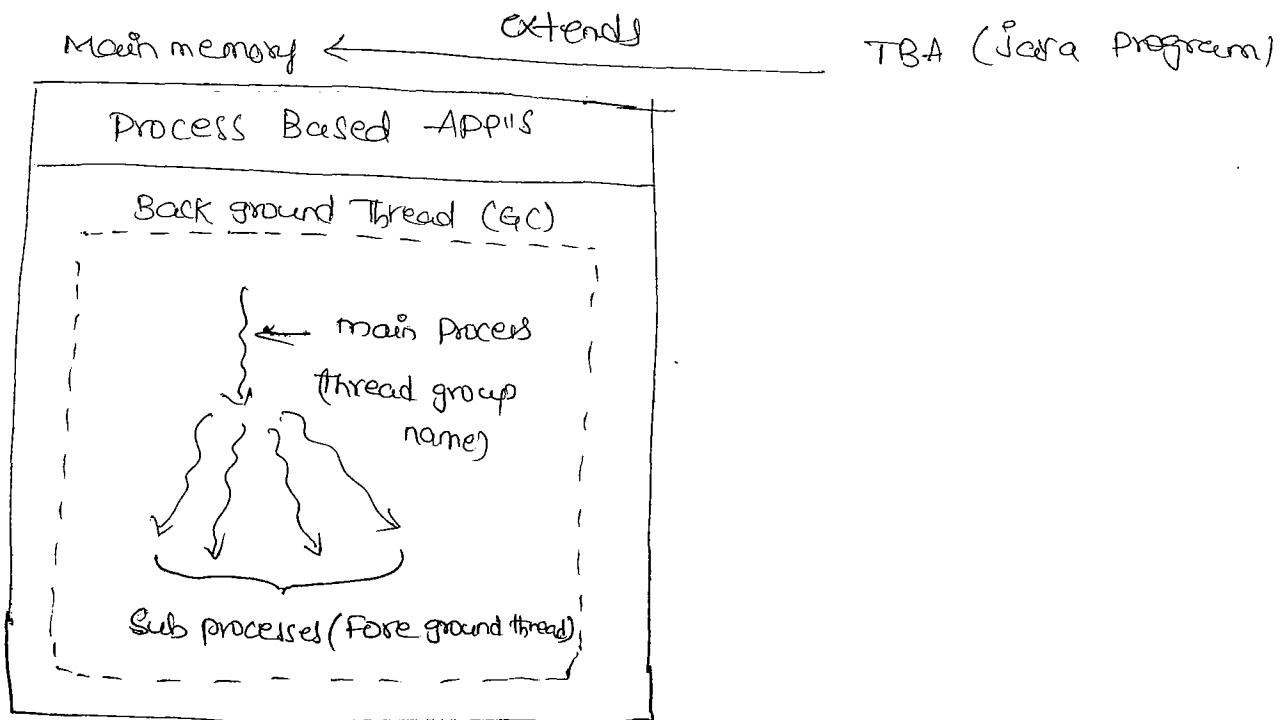
Whenever we execute any TBA then it will be considered

as PBA & in which one main process will be created. The main process internally creates sub processes. In Java programming

point of view - the main process is called Thread group name & the sub processes are called Foreground Threads & they meant for executing the methods which contains logic of Java program

concurrently. The following diagram gives view about the threads

layers.



Whereas a PBA will be considered as PBA only but not treated as TBA becoz there exist only one process which is considered as one thread only & there is no possibility of creating multiple threads.
(green thread)
The if

States of a thread (or) life cycle of a thread :-

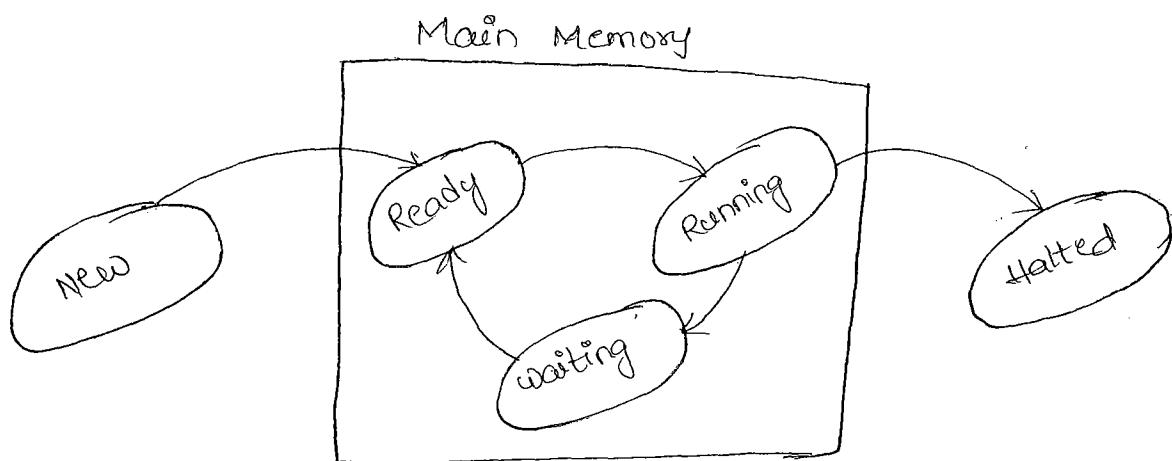
The different breaking points / Stages occurring in the execution of logic of the java program by the thread are known as States / life cycle of a thread.

States of thread are classified into 5 types. They are

1. New State
2. Ready State
3. Running State
4. Waiting State
5. Halted State

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State chart diagrams:-



New State:-

In this state, thread is created & about to enter into ready state.

Ready State:-

In this state, thread is entered into main memory, memory space is created for the thread & thread is waiting 1st time for the CPU.

Running State:-

In this state, thread is under the control of CPU. In other words,

is written in the form of user defined program then the state of the thread is running state.

Defn of CPU burst time:-

It is an amount of time taken by the thread from the device CPU for complete execution of the logic of the given program is called CPU burst time.

CPU burst time is decided by OS but not by programmer.

Halted State:-

In this state, thread completed its execution.

Waiting State:-

A thread is said to be in waiting state if & only if it satisfies any of the following factors.

- a, Thread is coming to executing state for the remaining CPU burst time.
- b, Suspending currently executing thread.
- c, Making the currently executing thread to sleep for the period of time in terms of msec [$1\text{ sec} = 1000\text{ msec}$]
- d, Making the currently executing thread to wait for a period of time in terms of msec
- e, Making the currently executing thread to wait without time
- f, Joining the threads.

Hence, as long as thread is in New & Halted States (out memory states) whose execution started is False, whereas as long as thread is in Ready, Running & Waiting States (in-memory states) whose execution started is True.

Q: How do you justify threads of Java executes concurrently? (216)
Ans Let us assume if threads of Java executes with the difference of hours, minutes, seconds then it will be considered as slowest execution/ sequential execution. Becoz, we can differentiate difference of hours, minutes, seconds. If threads of Java executes with the difference of milliseconds of time then it will be concurrent execution considered as fastest execution. becoz we can hence in the Java execution environment threads are executing concurrently with the difference of msec of time by following Round Robin Algorithm.

NOTE: Difference of msec of time is not able to be differentiated by human being calculations & we feel that all at once execution

Creating a thread

WKT the purpose of creating a thread is to execute logic of the Java program which is re-written in the form of a method

In Java programming we've 2 approaches to create a thread. They are

1. By using `java.lang.Thread` class
2. By using `java.lang.Runnable` Interface

By using `java.lang.Thread` class:-

By using `java.lang.Thread` class we create its object in 3 ways. They are

- a. Directly with new operator :-

`Thread t1 = new Thread();`

b. By using factory method:-

Thread t₁ = Thread.currentThread()

c. By using an object of sub class of Java.lang.Thread :-

```
class Th1 extends Thread  
{  
    ==  
}  
Th1 t1 = new Th1();
```

Here t₁ is an object of Th1 & Th1 is a sub class of Java.lang.Thread. Indirectly, t₁ is an object of Java.lang.Thread class.

*Profile of Java.lang.Thread :-

Data Members:-

Public static final int MAX_PRIORITY (=10)

Public static final int NORM_PRIORITY (=5)

Public static final int MIN_PRIORITY (=1)

The above data members are called thread Priority modifiers. The purpose of thread priority modifiers is that makes the CPU to understand which threads to execute first, second & last.

The default priority of the thread is NORM_PRIORITY (=5)

Constructors:-

i. Thread() :- (Default constructor)

This constructor is used for creating an object of Thread class without giving user friendly name to the thread.

Ex:- Thread t₁ = new Thread();

If we create 'N' no. of Thread class objects with this default constructor then whose default names starts with Thread-0, Thread-1, ..., Thread-N-1 & they are not recommended to give & always recommended to give user friendly names to the thread.

2. Thread (String) :- (Parameterized constructor)

This constructor is used for creating an object of Thread by giving user friendly name to the thread.

Ex:- Thread t₁=new Thread("Sathya");

↑

ref. variable/obj name

user friendly name

3. Thread (Runnable) :- (Object parameterized constructor)

This constructor is used for converting Runnable interface object into Thread class object for making use of all the methods of Thread class especially start() to enter into the overridden run() of Sub class of Runnable interface.

Ex:- Thread t₁=new Thread();

(or)

Runnable t₁=new Thread();

//t₁.start(); // invalid

Thread t₁=new Thread(t₁); // Thread-0

t₁.start(); // valid

4. Thread(Runnable, String) :-

The purpose of this constructor is similar to the above constructor & with this constructor additionally we are giving user friendly name to the thread.

Ex:- Runnable r = new Thread();

// r.setName("Sathya"); // Invalid

Thread t1 = new Thread(r, "Sathya");

Sop(t1.getName()); // Valid - Sathya

Instance Methods :-

1. Public final void setName(String)

2. Public final String getName()

The above methods are used for setting the user friendly name to the thread & getting the user friendly name of the thread.

Ex:- Thread t1 = new Thread();

String tname = t1.getName();

Sop(tname); // Thread-0

t1.setName("Sathya");

tname = t1.getName();

Sop(tname); // Sathya

Q:- Define mutators & inspectors?

Ans- A mutator is a type of method which will change the values of the object & whose generalized notation is `SetXxxx()`

Inspector is also one type of method which will obtain the value from the object & they starts with `getXxxx()`

3. Public final void setPriority (int)

4. Public final int getPriority ()

The above methods are used for setting the priority to the thread & getting the priority of the thread.

```
Thread t1 = new Thread (Seethya);
```

```
int PV = t1.getPriority();
```

```
Sop(PV); // 5 => NORM_PRIORITY
```

```
t1.setPriority(Thread.MAX_PRIORITY);
```

```
PV = t1.getPriority();
```

```
Sop(PV); // 10 => MAX_PRIORITY
```

5. Public boolean isAlive();

This method is used for checking the executing state of the thread. This method returns TRUE provided the thread is in in-memory states (Ready, Running & Waiting). & this method returns FALSE when thread is in Out-memory states (New & Halted).

6. Public void run()

This method is used for providing the definition of logic of the Java program. In otherwords, the logic of the Java program is written by to be executed by the thread to be written in run(). This method originally contains null body & it is to be always to be overridden by the programmer for providing logic of the thread.

Q 28/8 7. Public final void start():-

When we call start() upon the thread class object, internally start() will perform the following operations.

1. It moves the thread from New State to Ready State.
2. Provides multi-threading services (concurrency, synchronization & Intel Thread Comm. (ITC))
3. It automatically calls run(), which contains logic of the thread.

Hence, in order to develop any thread based apps we choose a class, it must extends `java.lang.Thread` class & we must override `run()` with the logic of the thread.

Ex:-

```
class Th1 extends Thread
```

```
{
```

```
    public void run() // overridden
```

```
{
```

```
    == // logic of a thread
```

```
}
```

```
}
```

```
Th1 t1 = new Th1(); // New State
```

```
boolean state = t1.isAlive();
```

```
sop("State"); // False
```

```
t1.start(); // Ready State.
```

```
state = t1.isAlive();
```

```
sop("State"); // True
```

The best approach for development of thread based apps is to create an object of `java.lang` sub class of `java.lang.Thread` class.

8. Public final void suspend():-

This method is used for suspending the currently executing thread. When the thread is suspended it stops its execution temporarily. Execution details are placed in PCB & transferred to Waiting state.

Ex:-
t1.suspend();

NOTE:-

A PCB is one of the buffer it contains temporary execution details of the thread. PCB created by OS when the thread is entered first time in Ready State.

9. Public final void resume():-

This method is used for transferring suspended thread from Waiting state to Ready state. When the thread is resumed (restarted) it starts continuing its execution where it left off. By retrieving the temporary execution details from PCB.

Ex:- t1.resume();

10. Public final void stop():-

This method is used for terminating/stopping the current thread execution & stopped threads will be entered into Halted state. When we restart the stopped threads they start continuing their execution from the begining but not from the place where they stopped.

11. Public final getThreadGroup getThreadGroup():-

This method is used for obtaining thread group name of current foreground thread.

Th1 t1 = new Th1();

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ThreadGroup tg = t1.getThreadGroup();

Sop(tg); // [name=main]
MAX_PRIORITY = 10

12. * Public final Thread.State getState():

This method is used for finding name of the thread state.

This method returns an object of State which is the inner nested class of Thread class.

Ex:-

Th1 t1 = new Th1(); // New state

boolean estate = t1.isAlive();

Sop(" Exec. State of t1 = " + estate); // False

Thread.State ts = t1.getState();

Sop(" State Name = " + ts); // NEW

13. * Public final void join() throws java.lang.InterruptedException:

This method is used for joining the threads which are completed after their execution as a single unit. This method strengthens the performance of multithreading apps by joining completed threads as a single unit & handover to garbage collector.

The default environment of multithreading says collects the individual threads after their execution & handover to garbage collector individually. This is one of the time consuming process.

This method throws a predefined exception called

"InterruptedException".

When InterruptedException occurs:

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It is one of the checked exception, this exception never occurs in stand alone machines, but it rarely occurs in busy environment like client server environment due to mis memory management of server side os.

Situation:-

Let us assume 'n' threads are created, Started their execution, n-1 threads are completed their execution & joined any nth thread is still under execution. Due to mis memory management of server side os, the ThreadGroupName is attempting to collect all the threads including nth thread. At this point of time wrt nth thread JVM generates a predefined exception called "Java.lang.Interruptedexception".

Ex:-

```
=====
try {
    t1.join();
    t2.join();
    =====
    tn.join();
}
catch(Interruptedexception ie)
{
    System.out.println("problem in thread execution");
}
```

Static Methods :-

1. Public static final Thread currentThread(); :-

It is one of the factory method. The purpose of this method is to find the threads which are by default running in Java environment.

Ex:- Thread t = Thread.currentThread();

System.out.println(t); // Thread [main, 5, main]

t.setName("Sathya");
 ↑ ↑ ↑
 FRT Priority TGN

System.out.println(t); // Thread [Sathya, 5, ~~Sathya~~^{main}]
 ↑ ↑ ↑

FRT Priority

TGN - priority is

already 10 [MAX_PRIORITY]

2. Public static final void sleep(long) throws java.lang.InterruptedException :-

This method is used for making the currently executing thread to sleep in terms of milli's. Once the sleeping time is overed automatically the thread will goes to ready & running states.

Once the thread is sleeping, it is in waiting state & no further operations will be performed until sleep-time completed. This method throws a pre-defined exception called java.lang.InterruptedException.

Let us assume first program threads are sleeping in some location of server side or, due to mis memory management of server side or, second program threads are attempting to sleep in the same location where first program threads are sleeping. At this point of time w.r.t first program thread JVM generates a predefined exception called InterruptedException.

Eg:-

try
 {

 Thread.sleep(1000);

} catch (InterruptedException ie)

{
 System.out.println("Problem in thread execution");

* Write a Java program which will display preliminary info about the thread such as threads which are by default running & whose execution started, whose FGT, TGN, Default name of programmer defined FGT, whose execution started, startname, thread priority modifier values, parent of TGN etc

// Thdemo1.java

```
import static java.lang.Thread.*;  
class Thdemo1  
{  
    public static void main(String []args)  
    {  
        // default thread info  
        Thread t = currentThread();  
        System.out.println("default threads = "+t); // Thread[main, 5, main]  
        t.setName("Sathya");  
        System.out.println("default threads after md function = "+t); // Thread[Sathya, 5, main]  
        String dft = t.getName();  
        System.out.println("default FGT = "+dft); // Sathya  
        Thread.State ts1 = t.getState();  
        System.out.println("State name of t = "+ts1); // RUNNABLE  
        System.out.println("exist status of t = "+t.isAlive()); // true  
  
        // thread group info  
        ThreadGroup tg = t.getThreadGroup();  
        System.out.println("default tg = "+tg); // Thread[name=main, maxpri=10]  
        ThreadGroup ptg = tg.getParent();  
        System.out.println("parent of default tg = "+ptg); // Thread[name=System]  
  
        // prog-def thread info  
        Thread t1 = new Thread();  
        System.out.println("name of prog-def FGT = "+t1.getName()); // Thread-0
```

```

    Sop("exe state of t1=" + t1.isAlive()); //false
    Thread.State ts = t1.getState();
    Sop("state name of t1=" + ts); //NEW
    // print thread priority modifier info
    Sop("val of max pri=" + MAX_PRIORITY); //10
    Sop("val of norm pri=" + NORM_PRIORITY); //5
    Sop("val of min pri=" + MIN_PRIORITY); //1
}
}

```

318 Internal flow of threads:-

Whenever we write any Java program it contains multiple threads & as a Java program we must understand the internal flow of the threads.

The following sequence of steps gives the internal flow of threads

1. Java program starts its execution
2. JVM creates TGN [TGN always resides in main()]
3. TGN creates FGT(s) [FGT(s) resides & execute run()]
4. TGN dispatches (starts) the FGT(s) to execute respective run().
5. FGT(s) execute respective run() & gives result back to TGN either one by one (or) all at once.
6. TGN receives the result from FGT(s) either one by one (or) all at once
- 7 TGN gives the result to JAVA programmer/Application user either one by one (or) all at once
- 8 TGN collects the FGT(s) & hand over to garbage collector
9. JVM collects the TGN & hand over to garbage collector
10. Java program stops its execution.

* Write a thread based app which will print 1-10 after each & every second. (288)

11Thdemo2.java

Class Th1 extends Thread

{

Public void run()

{

try

{

for(int i=1; i<=10; i++)

{

SOP("Val of i = "+i);

Thread.sleep(1000);

} //for

} catch(InterruptedException ie)

{

sep("prob in thread exec--");

}

} //run

} //th1 -- user defined class

Class Thdemo2

{

Public static void main(String [] args)

{

Th1 t1 = new Th1(); //new state

SOP("exec started of t1 before start = "+t1.isAlive()); //false

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```

t1.start();
sop("exec started of t1 after start = "+t1.isAlive()); //true
try
{
    Thread.sleep(5000);
} catch(InterruptedException ie)
{
    sop("prob in thread exec--");
}
sop("exec started of t1 during execution - line - 35
= "+t1.isAlive()); //true
try
{
    Thread.sleep(5001);
} catch(InterruptedException)
{
    sop("prob in thread exec--");
}
sop("exec started of t1 after execution -- line - 43
= "+t1.isAlive()); //false
}

```

The some other best solutions for printing the execution
 Started of the FGT after its completion are

1. Substitute `t1.join()` in place of `Thread.sleep()` [use `join()`]
2. Subs use while (`t1.isAlive()`)

{
 }
 in place of `Thread.sleep` stmt.

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By using Java.lang.Runnable :-

(20)

- It is one of the pre-defined functional interface present in Java.lang.* package
- This interface contains only one method & whole prototype is given below

Public abstract void run()

→ The run() of Thread class contains null body & run() of Runnable interface is abstract.

→ It is highly recommended to override abstract run() of Runnable interface instead of overriding null body run() of Thread class.

→ Java.lang.Runnable interface is an alternative solution for development of multi-threading apps instead of using Java.lang.Thread class

Consider the following invalid code segment which is not possible to develop multi-threading apps

class Th1 extends Satya, Thread { Invalid code }

```
{  
  ==  
 }  
}
```

To overcome the above multiple inheritance problem we rewrite the above code as follows with the help of Runnable interface.

class Th1 extends Satya implements Runnable { Valid code }

```
{  
  ==  
 }  
}
```

Hence, to develop multithreading applications with Runnable interface, we choose their user defined class, it must implements Runnable interface & override run()

class Th1 implements Runnable

{

public void run() { overridden

{

 // Logic of a thread.

}

}

* Write a thread based appli which will print 1 to 10 no. by using Runnable interface

// Thdemo6.java

class Th1 implements Runnable

{

 public void run()

{

 try

{

 for (int i=1; i<=10; i++)

{

 System.out.println("val of i = " + i);

 Thread.sleep(1000);

} // for

} catch (InterruptedException e)

{

 System.out.println("Prob in thread exec--");

}

} // run

class Thdemo6

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O

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O

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O

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O

O

O

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O

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O

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O

O

O

{ public static void main(String []args)

{

// Th1 t1=new Th1(); // new state (OR)

Runnable t1=new Th1();

Thread t1=new Thread(t1, "athya"); // converting Runnable object into Thread class
SOP("name of FG=" + t1.getName()); // Athya object

SOP("exec started of t1 before start =

" + t1.isAlive()); // false

t1.start();

SOP("exec started of t1 after start =

" + t1.isAlive()); // true

}

}

* Develop a thread based appli for computing sum & sub of 2 no's
concurrently

import java.util.Scanner;

class Sum extends Thread

{

int a,b,c;

void set(int a, int b)

{

this.a=a;

this.b=b;

}

public void run()

{

c=a+b;

```
3 System.out.println("sum = " + c);
```

```
3 } //sum
```

Class Sub implements Runnable

```
{
```

```
int a, b, c;
```

```
void set(int a, int b)
```

```
{
```

```
this.a = a;
```

```
this.b = b;
```

```
}
```

```
public void run()
```

```
{
```

```
c = a - b;
```

```
System.out.println("sub = " + c);
```

```
}
```

```
} //Sub
```

Class Thdemo7

```
{
```

```
public static void main(String[] args)
```

```
{ //accept the values from KBD
```

```
Scanner s = new Scanner(System.in);
```

```
System.out.println("Enter first value");
```

```
int x1 = Integer.parseInt(s.nextLine());
```

```
System.out.println("Enter Second value");
```

```
int x2 = Integer.parseInt(s.nextLine());
```

// create the threads

```
Sum s1 = new Sum();
```

```
Sub s2 = new Sub();
```

// Set the values to threads for compute sum & sub operations

S1.set(x1, x2);

S2.set(x3, x4);

// dispatch the threads

S1.start();

// S2.start(); Invalid

Thread t22 = new Thread(S2); // converting obj of sub class

t22.start(); of Runnable into obj of Thread class

// join the FGTs

try

{

S1.join();

t22.join();

} catch (InterruptedException ie)

{

sep("prob in thread exec ..");

}

// check the execution started before joined

SOP("exec started of S1=" + S1.isAlive() + " and

" State Name=" + S1.getState()); // TERMINATED (halted)

SOP("exec started of t22=" + t22.isAlive() + " and

" State Name=" + t22.getState()); // TERMINATED (halted)

}

}

NOTE:- In general if we want to execute multiple independent ~~operations~~
concurrently then we must choose multiple independent class & they must
implement Runnable & implements JavaLang.Runnable & use

NOTE

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Java.lang.Thread is internally implementing Java.lang.Runnable interface
Provider null body for run()

* Write a java program which will implement banner animation or
WAPF for scrolling the given message

//Ani.java

import java.awt.*;

import java.applet.*;

/* <applet code="Ani" height=300 width=300 >

</applet> */

public class Ani extends Applet implements Runnable

{

String msg = "JESUS SAVES US";

public void init()

{

setBackground(Color.PINK);

setForeground(Color.GREEN);

}

public void start()

{

Thread t = new Thread(this); // 'this' refers to current
class obj. which implements 'Runnable' interface & converts
into Thread class obj

t.start();

}

public void run()

{

try

{

```

    {
        char ch=msg.charAt(0);
        msg=msg.substring(1,msg.length());
        msg=msg+ch;
        Thread.sleep(1000);
        repaint();
    } // while
} catch(InterruptedException ie)
{
    System.out.println("prob in thread exec--");
}
} // run()
public void paint(Graphics g)
{
    Font f=new Font("arial",Font.BOLD,60);
    g.setFont(f);
    g.drawString(msg,100,100);
}
} // ani-class

```

* Write a Java thread based applet which will automatically increment the numbers

```

//AutoInc3.java
import java.awt.*;
import java.applet.*;
<applet code="AutoInc3" height=300 width=300></applet>
public class AutoInc3 extends Applet
{
    int i=0;
    ...
}
```

SetBackground('color: Blue');

SetForeground ('color white');

Public void Start()

{

Sathya s = new Sathya (this); // capturing the current class
obj entering into Sathya class

Thread t = new Thread(s); It's 'refers to obj of INOP class
which implements 'Runnable' intf & converts into Thread class obj
t.start();

}

Public void paint(Graphics g)

{

Font f = new Font ("arial", Font.BOLD, 60);

g.setFont(f)

g.drawString (String.valueOf(i), 100, 100);

}

} // AutoInc - outer class

Class Sathya implements Runnable // INOP class

{

AutoInc a;

Sathya (AutoInc a) // object parameterized constructor

{

this.a = a;

}

Public void run()

{

try

{

while (true)

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{

a. i++;

a. repaint();

Thread.sleep(1000);

} // while

} catch (InterruptedException e)

{

System.out.println("prob in thread exec");

}

} // main

} // Synchronization

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Synchronization

Synchronization is the concept of OS & it is available in Java as a predefined facility with the aim of building thread safety applications.

Safety applications

If multiple threads execute (or) performs the operations on the same resource then by default we get inconsistent results / dead lock results which is not a recommended process. To overcome this problem we apply the concept of synchronization.

The advantage of synchronization concept is that preventing the dead lock results & generating consistent/thread safety results.

Defn of Synchronization:-

The process of allowing one thread among multiple threads into the shareable area for perform write & read operations for getting consistent result by eliminating inconsistent results is synchronization.

→ Synchronization concept is always recommended to apply on ^(Q7) shareable operations & not recommended to be apply on independent operations.

Need of synchronization:-

Let us assume there is a shareable variable balance & whose initial value is zero. Let us assume there exist two threads decided to deposit Rs. 10 & 20 respectively in the balance of account concurrently. When both the threads started their execution for depositing & after completion of their execution the result of the balance variable is either 10/- or 20/- but not 30/- which is one of the inconsistent result. To overcome this inconsistent result we must apply the concept of synchronization.

Synchronization applied (on the above problem)

Let us assume both the threads started their execution at the same time (t_1 starts first & later t_2 with the difference of milli seconds of time) then JVM gives value of balance (Rs. 0) to the t_1 & balance variable locked by JVM & thread t_2 mayed wait until thread t_1 completes its execution. Thread t_1 completed its execution, JVM unlock the balance variable, JVM gives value of balance (Rs. 10) to thread t_2 & once again balance variable will be locked. Thread t_2 also completed its execution & balance variable will be unlocked. The final result of the balance variable is 30/- which is one of the consistent result.

Hence, during the synchronization process JVM continues the process of locking & unlocking until all the threads completed their execution.

Thread synchronization Techniques

(300)

We've 2 types of synchronization techniques

1. Synchronized methods

a. synchronized instance method

b. synchronized static method

2. Synchronized blocks

Synchronized Methods :-

Synchronized methods are classified into 2 types. They are

1. synchronized instance method

2. synchronized static method

1. Synchronized instance method :-

If an ordinary instance method accessed or executed by multiple threads concurrently they by default we get inconsistent result. To overcome this inconsistent results of ordinary instance methods, whose defns must be made as synchronized by using "synchronized" keyword.

Syntax :-

synchronized Ret type methodname(List of formal Params if any)

{

Block of Stmt(s) -- Business logic - Thread Safety results

}

As long as the thread is executing synchronized instance method it will lock object of corresponding class.

Ex:- class Account

(80)

{

 private int balance=0;

 synchronized void deposit(int amt){ //writable method

{

 bal=bal+amt;

 System.out.println("curr bal=" + bal);

}

}

AS long as thread executing ^{the above} synchronized instance deposit()
then JVM will lock an object of account class

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2 Synchronized static method :-

When an ordinary static method accessed by multiple

threads concurrently then we get inconsistent result.

To overcome these inconsistent results the defn of ordinary
static method must be made as synchronized by using
synchronized keyword.

Syntax :-

 synchronized static RetType methodname (List of formal
 params if any)

{

 Block of stmts - Business logic - Thread Safety result

}

Ex:- class Account

{

 private int bal=0;

 synchronized static void deposit(int amt)

{

 bal=bal+amt;

 System.out.println("curr bal=" + bal);

,

As long as the thread is executing the above synchronized static deposit() JVM will lock the account class.

In general as long as the thread is executing synchronized static method JVM will lock corresponding class

During the synchronization process JVM is locking either an object (or) class depends on ^{type of} synchronized method executed by JVM.

Synchronized Block:-

Synchronized block is an alternative mechanism for obtaining thread safety results instead of using synchronized methods.

- synchronized blocks to be written inside the non synchronized instance method
- all synchronized blocks always makes the JVM to lock an object of corresponding class

Syntax:-

synchronized(obj of current class)

{

Block of statements - Business logic - Thread safety relates

}

Need of synchronized block:-

Whenever we inherit non-synchronized instance methods either from base class/ intf to derived class & if the inherited non-synchronized instance method accessed by multiple threads
..... to not consistent result as

- a denied class programmer attempting to write "synchronized" keyword before inherited non-synchronized instance method
- which is not a recommended process & to overcome this problem we use synchronized blocks.

Ex:-

```
interface Account
{
    void deposit(int);
}
```

```
AbstractClass Account
{
    void deposit(int amt)
}
```

Class SavingAccount implements Account
Extends

```
{
    int bal=0;
    public void deposit (int amt)
    {
        Synchronized (this)
        {
            bal = bal + amt; → synchronized block
            System.out.println("curr bal = "+ bal);
        }
    }
}
```

* Write a java program which illustrate the concept of synch problem Stmt:- Let us assume there exist an account with the balance & whose initial value is zero. On Account perform the operations like depositing & balance enquiry.

Let us assume there exist n-no. of customers who decided to deposit rupee 10/- by each concurrently in the balance of Account. Ensure that during the concurrency we must get consistent result in the balance of account.

5/9/16

USync.java

class Account

{

private int bal = 0;

synchronized void deposit(int amt)

{

bal = bal + amt;

System.out.println("curr bal = " + bal);

}

int getBal()

{

return bal;

}

} //Account

class cust extends Thread

{

Account ac;

cust(Account ac)

{

this.ac = ac;

}

public void run()

{

ac.deposit();

}

} //cust

Class Sync

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```
{  
    public static void main(String[] args)  
    {
```

// Create the single object of Account

```
        Account ac = new Account();
```

// Create the array of obj of cust(threads)

```
        Cust cu[] = new Cust[5];
```

// Give a single obj of Account to cust class objects

```
        for (int i = 0; i < cu.length; i++)
```

```
{
```

```
            cu[i] = new Cust(ac);
```

```
}
```

// Dispatch the array of cust object to deposit rs 10/- by
each in the bal of Account

```
sop("-----");
```

```
        for (int i = 0; i < 5; i++)
```

```
{
```

```
            cu[i].start();
```

// Join the array of cust objects

```
try
```

```
{
```

```
        for (int i = 0; i < cu.length; i++)
```

```
{
```

```
            cu[i].join();
```

```
}
```

```
} catch (InterruptedException e)
```

```
{
```

```
    sop("prob in thread exec--");
```

```
}
```

1) Print total bal.

```
sop("-----");
sop("\n\n TOTAL BAL = " + ac.getBal());
sop("-----");
} // main()
} // sync.
```

NOTE: When we execute synchronization based app's (sync.java)

on mono/single user OS's (DOS, Windows 3.1 & Windows 95) then

it is mandatory to the Java programmer to ~~say~~ write

Synchronized keyword. Otherwise we get inconsistent result because

even though there exist synchronization concept in OS, which is

not implemented in mono OS's. If we used synchronized keyword explicitly as a part of our Java program then we are

using Java based synchronization keyword & it gives consistent

result during the order of updation & final result.

NOTE: 2 When we execute synchronization based app's on multi

threaded / multi user OS's (Windows, WinXP, UNIX, LINUX etc) then

writing synchronized keyword is optional. because synchronization

concept of OS implemented in multi-threaded OS's. If we don't

use synchronized keyword then the multi-threaded OS's will provide

OS based synchronization. Due to this we get consistent final result

but order of updation is inconsistent which is not a recommended process.

NOTE: 3 Irrespective of type of OS being used, industry is highly

recommended to use Java based synchronization for getting

consistent result during Order of updation & final result.

Inter thread communication (ITC)

307

- ITC concept of java is the specialized form of inter process com. & os.
- ITC based apps are fastest apps compared to IPC apps because ITC apps are light weight components (thread based technology) whereas IPC apps are heavy weight components (process based technology)
- The real time implementations of ITC concept are
 - (a) Development of mobile based application
 - (b) Development of real world server s/w
 - (c) Development of universal protocols

Defn of ITC :-

The process of exchanging the data/information btw multiple threads with the consistent comm. is known as Inter thread communication.

(OR)

If the obj of 1st thread is given an i/p to 2nd thread & obj of 2nd thread is given an i/p to 3rd thread etc then the consistent com. btw 1st, 2nd & 3rd threads is known as Inter thread com?

To develop ITC apps we use the pre-defined methods present in `java.lang.Object` & they are called ITC methods.

ITC methods in `java.lang.Object` :-

1. Public final void wait(long)
2. Public final void wait()
3. Public final void notify();
4. Public final void notifyAll();

Method 1 is used for making the thread to wait for a period of time. Once the waiting time is completed automatically the thread will be entered into ready state. One more detail,

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the next thread to wait until the CPU burst time of current thread is completed which may not be known to the java programmer bcoz CPU burst time is not decided by programmer but it is decided by OS. This method is not advisable to use.

Method :-2 is used for making the thread to wait without any time. this method is advisable to use.

The above 1&2 methods throws the pre-defined exception called `java.lang.InterruptedException` [for more explanation see `Sleep()` Previous Pages].

Method :-3 is used for transferring one thread at a time from waiting state to ready state.

Method :-4 is used for transferring all the threads from waiting state to ready state.

Classical examples of DTC (From Isp) :-

1. Producer-consumer problem
2. Dining-Philosophers problem
3. Readers-writers problem
4. Barber shop problem

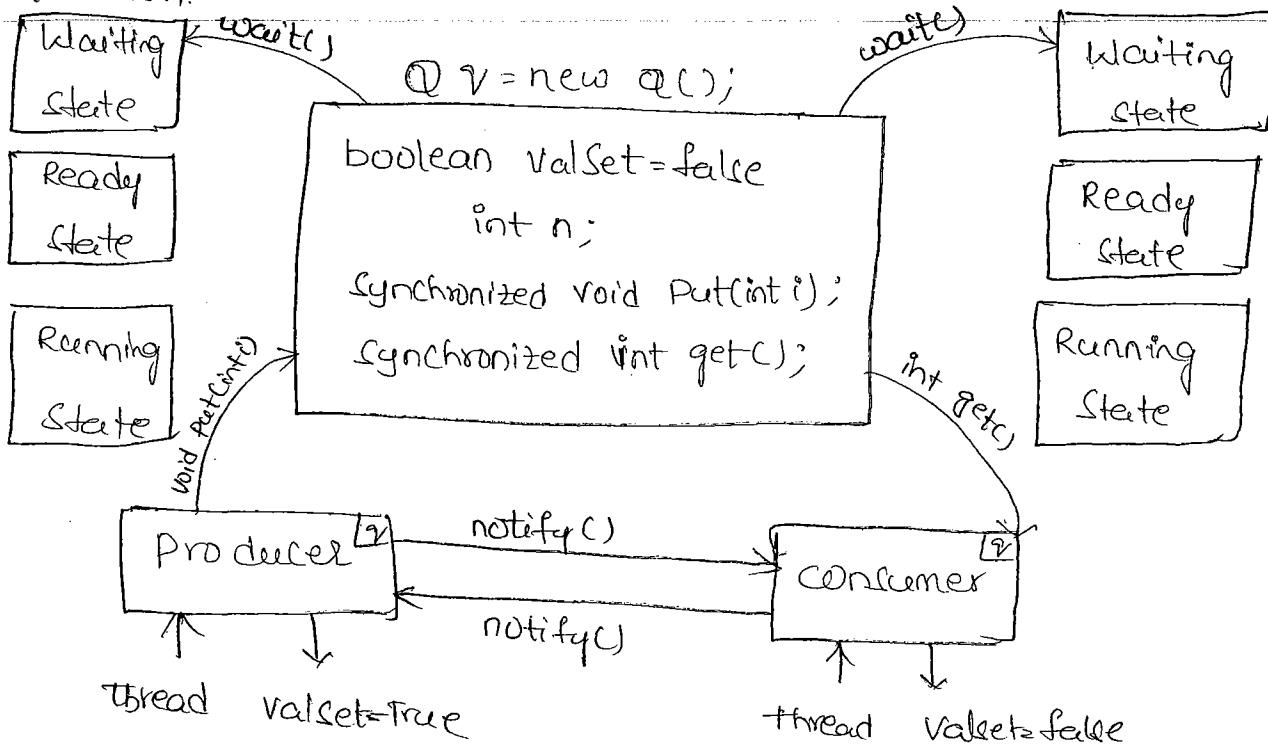
Implementation of producer-consumer problem:-

producer- It is one of the thread which is always producing the items/values which are consumed by consumer. At any point of time the producer thread will produce only one item at a time but not multiple items.

consumer- It is the thread used for consuming the items/values which are produced by producer thread. At any point of time consumer will consume only one item at a time but not multiple items.

The following diagram gives implementation of Producer-Consumer

Problem.



* Write a java program which will implement producer consumer problem.

/*Pcpc.java

class Q

{

 boolean valSet=false;

 int n;

 synchronized void Put(int i)

{

 try

{

 if(valSet)

{

 wait(); // pt is waiting

}

? catch (InterruptedException e)

{ Sepc" prob in thread exec--");

}

n2i;

sop("put= "+n);

valset=true;

notify();

} // putc()

Synchronized int get()

{

try

{

if (!valset)

{

wait(); // if !s waiting

}

} catch (InterruptedException ie)

{

Sepc" prob in thread exec--");

}

sop("got= "+n);

valset=false;

notify();

return n;

} // get()

} // Q-- BLC

class Prod implements Runnable

(31)

{

Q q;

Prod(Q q)

{

this.q = q;

Thread ct = new Thread(this); // 'this' refers current

ct.start();

}

public void run()

{

int i = 0;

while(true)

{

System.out.println(i++);

} // while

} // run

} // prod --- Block --- Thread

class Cons implements Runnable

{

Q v;

Cons(Q v)

{

this.v = v;

Thread pt = new Thread(this);

pt.start();

}

public void run()

{

while(true)

{

..

class obj which impl
Runnable intf & converting
into Thread class obj
for calling start()

(312)

```

} // while

} // ren()

} // cons ---BLC--- Thread

class Facpc
{
    public static void main(String [] args)
    {
        Q q = new Q();
        Prod p0 = new Prod(q);
        Cons c0 = new Cons(q);

        } // main()
    } // Facpc

```

compile the above program

javac Facpc.java

Run the program

java Facpc

Output.

Put=1

got=1

Put=2

got=2

Put=3

got=3

In the above op Put msg's are generated by Prod thread & got msg's are generated by Consumer thread consistently. Hence the consistent comⁿ btwn prod & cons thread is known as ITC.

- * Write a java program which will print name of the programme defined FGT during the execution of run(). where the user-defined class either extends Thread or implements Runnable.

// Exam1.java

class Th1 implements Runnable

{

 Public Void run()

{

 SOP("I am from run());

 Thread t = Thread.currentThread();

 Sop("thread in run() = " + t.getName()); // Thread[satya, sunil]

}

}

class Exam1

{

 Public static Void main(String [] args)

{

 Th1 t1 = new Th1();

Sol1 extending thread class

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In the run method write the following code

System.out.println("Name of FGT = " + getName());

System.out.println("Name of FGT = " + Thread.currentThread.getName());

Sol2 implementing Runnable intf

System.out.println("FGT in main run() = " + Thread.currentThread.getName());

Exam2.java

class Th1 implements Runnable

{

 public void run()

 { System.out.println("Th1 --- default"); }

 Thread t1 = new Thread(this, "Sathyam");

 t1.start();

}

 public void run()

{

 System.out.println("I am from run()");

 System.out.println("FGT in run() = " + Thread.currentThread.getName());

}

} (Th1)

Class Exam2

{

 public static void main(String[] args)

{

 System.out.println("main()");

 new Th1();

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Collection Framework (Java.util.*)

(315)

- CFW is one of the additional service/add on service developed by SUN/MI developers with the aim of providing high performance to the Java based apps
- To deal with CFM programming we must import a pre-defined package called Java.util.*

Defn of CFW:-

It is one of the standard mechanism which allows to group multiple values either of same type (or) different type (or) both the types in a single variable with dynamic size. This single variable is called "collection framework variable".

What are the differences btw Arrays & CFW?

Array

1. An array is a collective name given to a group of consecutive memory locations which are all referred by similar type of values.
2. Concept of arrays allows to organize only homogeneous values but not heterogeneous values.
3. Arrays concept contains fixed size in nature.
4. Arrays concept belongs to non-serializable.

CFW

1. CFW is one of the standard mechanism which allows to group multiple values either of same type (or) different type (or) both the types in a single variable with dynamic size.
2. Concept of CFW allows to organize both homogeneous & heterogeneous values.
3. CFW provides dynamic size in nature.
4. CFW concept belongs to serializable.

Q:- What is the need of going for CFW when an array of objects of java.lang.Object is organizing all types of values

Ans:- Even though an array of objects of java.lang.Object is organizing all types of values, it has the following problems. (due to arrays nature).

a. Fixed size (additional size leads to ArrayIndexOutOfBoundsException)

b. Non-Serializable.

To overcome these problems industry is always recommended use the concept of CFW.

Advantages of CFW:-

If we use CFW's as a part of our Java appii then we get the following advantages.

1. CFW provides high performance
2. CFW provides expandability (depends on the incoming flow of the data, the size of the CFW variable will be \uparrow d.)
3. CFW provides Adaptability (the content of one CFW variable is adding to another CFW variable either in the begining (or) in the middle (or) in the ending is called Adaptability.)
4. CFW is one of the algorithmic oriented
 - 4.1. CFW provides built-in sorting techniques
 - 4.2. CFW provides built-in searching techniques.
 - 4.3. CFW provides preliminary services of data structures.

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Types of CFW

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In the initial days of SUN MS the concept of CFW was known as Data Structures. The data structures concept was able to fulfill few requirements of s/w industry & unable to fulfill few more requirements of industry. SUN MS Developers revised the existing data structures concept & released to the real world on the name of New CFW & the existing data structures is carry forwarded on name of Legacy CFW.

In other words we've 2 types of CFW's. They are

1. New CFW

2. Legacy CFW

New CFW:-

→ Revised form of existing data structures of Java is called

New CFW.

→ New CFW is classified into 2 types. They are

i. 1-D | Single CFW

ii. 2-D | Double | maps CFW

finding the value by keeping the key is mapping.

1-D CFW in New CFW:-

→ In 1-D CFW we organize the data in the form of either row/column but not in the form of rows & columns (or) not in the form of (K,V) pair

→ To deal with 1-D CFW programming we need to learn corresponding interfaces & classes present in java.util.*

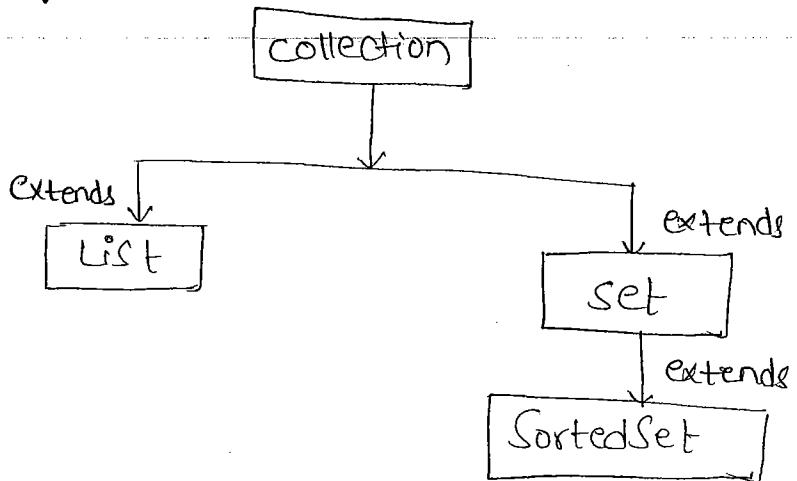
1-D CFW Interface:-

We've 4 1-D CFW interfaces. They are

1. Java.util.collection

3. Java.util.set

Hierarchy Chart-



Here, the objects of Collection, List, Set & SortedSet are called CFH Variables.

Differences b/w collection, List, Set & SortedSet :-

Objects of Collection & Set are called unidirectional objects. becoz they allows to retrieve the data only in forward direction.

The objects of List & SortedSet are called multidirectional objects becoz they allows to retrieve the data in forward, backward & Random direction.

Differentiation

factor

Collection

List

Set

Sorted Set

Hierarchy

It is one of the pre-defined interface available on the Top of hierarchy of I-O CFM interfaces

List is the sub interface of collection

Set is the sub interface of collection

SortedSet is the sub interface of Set

(3)

Functionality

An object of Collection allows duplicate elements

An object of List allows duplicate elements

An object of Set allows unique elements

An object of SortedSet allows unique elements

Display difference

Collection interface object displays the data in Random order

List interface object displays the data in sorted order

Set interface object displays data in Random order

SortedSet interface object displays the data in sorted order

Data organization

An object of Collection interface allows to add the data only at end

An object of List interface allows to organize the data either in the begining or in the middle or in the ending

An object of Set interface allows to add the data only at end

An object of SortedSet interface allows to organize the data either in the begining or in the middle or in the ending

Retrieval

Collection interface object allows to retrieve the data only in forward direction but in other directions

List intf object allows to retrieve the data in forward, backward & Random directions

Set intf object allows to retrieve the data only in forward direction but not in other directions

SortedSet intf object allows to retrieve the data in forward, backward & Random directions

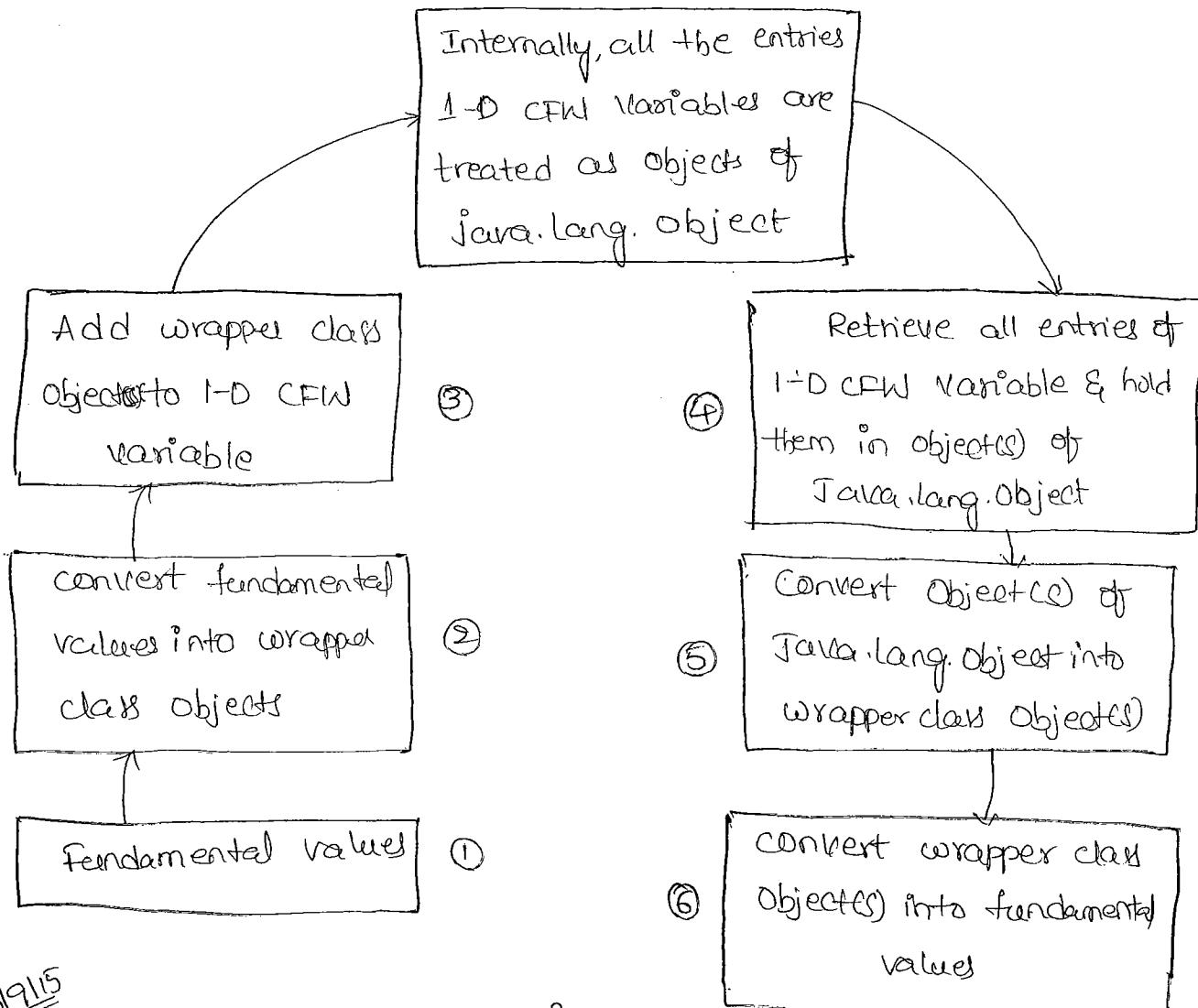
I-D CFW Process:-

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This process contains 2 phases. They are

1. Grouping / Assembling Phase
2. Un-grouping / De-assembling Phase

The following diagram gives sequence of steps for grouping & un-grouping phases.



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Object type casting in Java:-

Defn:- The process of converting reference of base class object into the reference of sub class object is called "Object type casting".

Syntax:-

Sub class
Name

Sub Obj = (Sub class)
Name Base class
Obj

Need of object Typecasting:-

1. The result of the Java program is available in the object of `Java.lang.Object`.

Ex:- `Object obj = "Saritha";`

2. To process the result of object of `Java.lang.Object` we are not having any methods present in `Java.lang.Object`.

Ex:- `int n = obj.length();` // Invalid, because `length()` doesn't exists in `Java.lang.Object`.

3. To process the result of object of `Java.lang.Object`, we have the special methods present in sub class of `Java.lang.Object`.

~~String~~ ↴

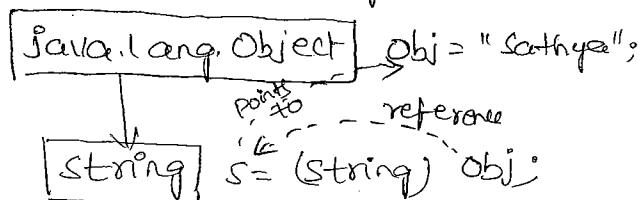
`public int length()`

4. TO process the result of object of `Java.lang.Object`, w.r.t the object of `Java.lang.Object`, we can't access special methods of sub class of `Java.lang.Object` (according to the scope of base class object) see in Inheritance topic.

5. TO process the result of object of `Java.lang.Object`, w.r.t the special methods of its sub class we apply the concept of Object Typecasting

`String s = (String) obj;`

Consider the following diagram.



* Write a Java program which illustrate the concept of ⁽²²⁾ ~~fund~~, type casting (implicit & explicit) & Object type casting.

```
 //TypeCast.java
 class TypeCast
 {
     public static void main(String [] args)
     {
         SOP("Fund. Type Casting");
         SOP("-----");
         int a=10;
         float b;
         b=a; //fund. implicit type casting
         SOP("Val of a(int)= "+a); //10
         SOP("Val of b(float)= "+b); //10.0
         float x=5.5f;
         int y=(int)x; //fund. explicit type casting
         SOP("Val of x(float)= "+x); //5.5
         SOP("Val of y(int)= "+y); //5
         int k=65;
         char l=(char)k; //fund. Explicit type casting
         SOP("Val of k(int)= "+k); //65
         SOP("Val of l(char)= "+l); //A
         char p='a';
         int q;
         q=p; //fund. implicit type casting
         SOP("Val of p(char)= "+p); //97
         SOP("Val of q(int)= "+q); //97
```

```

SOP("-----");
SOP("Object type casting");
SOP("-----");
Object obj = "SATHYA";
SOP("val of obj = "+obj); // SATHYA
// int noc = obj.length(); invalid
String s = (String) obj; // Object type casting
int noc = s.length();
SOP("no.of chars "+obj+" = "+noc);
Object obj1 = 100;
// obj1 = obj1 + 1; invalid
Integer i0 = (Integer) obj1; // Object type casting
i0 = i0 + 1; // auto un-boxing
SOP("val of obj1 = "+obj1); // 100
SOP("val of i0 = "+i0); // 101
int x1 = i0.intValue(); // programmatic un-boxing
x1 = x1 + 1;
SOP("val of x1 = "+x1); // 102
SOP("-----");

```

Methods in Java.util.Collection:-

1. public int size():

This method is used for finding the no. of elements¹ in a CFN variable

2. public boolean isEmpty():

This method returns true provided CFN variable is empty & it returns false when CFN variable is non-empty

3. public void clear():-

This method is used for removing/cleaning the elements of CFM variable.

4. public boolean contains(Object):-

This method returns true provided the specified values present in CFM variable otherwise it returns false.

Ex:-

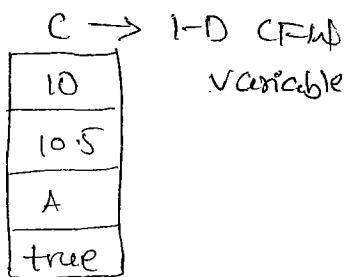
```
SOP(C); // [10, 10.5, A, true]
```

```
boolean b = C.contains(10.5);
```

```
Sop(b); // true
```

```
b = C.contains("Bathya");
```

```
Sop(b); // false
```



5. public boolean add(Object):-

This method is used for adding an element to any CFM variable & internally, those elements are treated as objects of Java.lang.Object.

This method returns true as long as we call w.r.t objects of Collection & List irrespective of type of elements we add this also returns true provided we call this method w.r.t Set & SortedSet & adding unique elements. This method returns false provided we add duplicate elements to Set & SortedSet interface objects.

Ex:- In JDK1.4

```
int a=10; → ①  
Integer i0 = new Integer(a); → ②  
C.add(i0); → ③
```

In JDK 1.4

C.add(new Integer(10));

FROM JDK 1.5 Version onwards

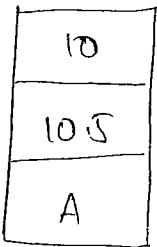
C.add(10);

C.add(10.5);

C.add('A');

SOP(C); // [10, 10.5, A]

C ← 1-D CFW Variable



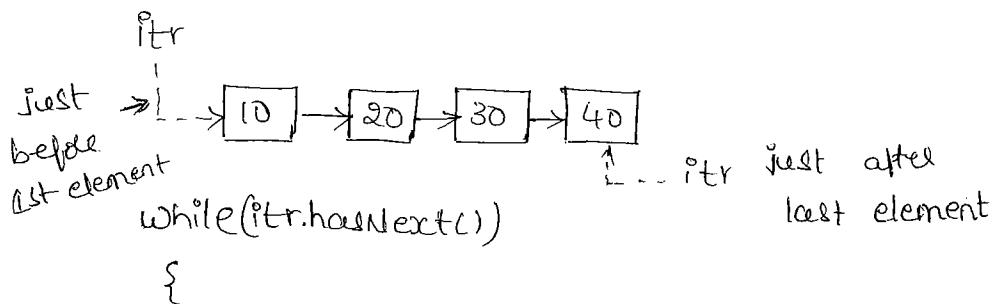
6. Public Iterator iterator()

This method is used for retrieving / extracting all the elements from CFW variable & forms a forward directional chain. This method returns an object of iterator interface & it is by default pointing just before the first element of forward directional chain.

Ex:- SOP(C); [10, 20, 30, 40]

int l=0;

Iterator itr = C.iterator();



Object obj = itr.next(); // ④

Integer i0 = (Integer) obj; // ⑤

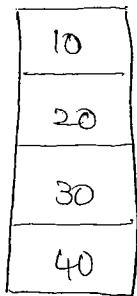
int x = i0.intValue(); // ⑥

SOP(x); // 10 20 30 40

S = l + x;

SOP(" sum = " + S); // 100

C → 1D CFW Variable



7. Public Object[] toArray() :-

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This method is used for extracting/retrieving all the elements of 1-D CFW variable & holding the array of objects of Java.lang.Object.

Ex:-

```
Sop(c); // [10,20,30,40]
```

```
int s=0;
```

```
Object obj[] = c.toArray(); //④
```

```
for(int i=0; i<obj.length; i++)  
{
```

```
    Integer i0 = (Integer) obj[i]; //⑤
```

```
    int x = i0.intValue(); //⑥
```

```
Sop(x); //10 20 30 40
```

```
s=s+x;
```

```
}
```

c - 1D CFW variable	
10	
20	
30	
40	

obj	
10	0
20	1
30	2
40	3

Iterators:-

- It is one of pre-defined interface present in Java.util.*
- The purpose of Iterator interface object is to extract the data from any CFW variable in forward direction only.
- By default an object of Iterator is pointing just before the first element of any CFW variable.

Methods:-

1. Public boolean hasNext()

2. public Object next()

Method-1 is used for checking whether we've next element or not. It returns true provided it contains next element.

Method-2 is used for retrieving next element provided true

Methods in `Java.util.List` :-

WKT `List` is the sub interface of `Collection` so that all the methods of `Collection` are inherited into `List` & `List` interface contains the following special methods.

1. Public void add(int, Object) :-

This method is used for adding an element to 1-D CFW variable (`List`) either in the beginning(0) in the middle (2) in the last.

Ex:-

0th location - "Sathya"

```
l.add(0, "Sathya");
```

2nd location - "Sathya"

```
l.add(2, "Sathya");
```

Last location - "Sathya"

```
l.add(4, "Sathya");
```

<code>l</code>	
0	10
1	105
2	A
3	true

Q:- How do you add an element "Sathya" at the end of existing elements of `List` object by using `add(int, Object)`

Ans:- `l.add(l.size(), "Sathya");`

2. Public Object get(int) :-

This method is used for obtaining / extracting the value from any 1-D CFW variable by passing valid position. Otherwise we get a predefined exception called `java.lang.IndexOutOfBoundsException`

Ex:- `Object obj = l.get(2);` ^{valid} position

```
System.out.println(obj); // 1.5
```

`Object obj2 = l.get(6);` ^{invalid} position

<code>l</code>	
6	10
1	1.5
2	Sathya

`Null`

`throws java.lang.IndexOutOfBoundsException`

3. Public void remove(Object)

(328)

Public Object removeElementAt(int) :-

The above methods are used for removing the elements of the 1-D CFM variable either on the basis of content
(a) On the basis of valid position.

Public void removeAll() :-

This method is used for removing all the elements of 1-D CFM variable.

4. Public ListIterator listIterator() :-

This method is used for extracting/retrieving the elements from 1-D CFM variable & forms bi-directional chain. This method returns an object of ListIterator & it is by default pointing just before the first element.

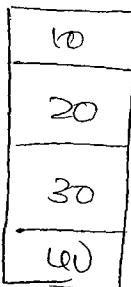
Ex :-

```
Sop(l); // [10, 20, 30, 40]
```

l - 1-D CFM Variable

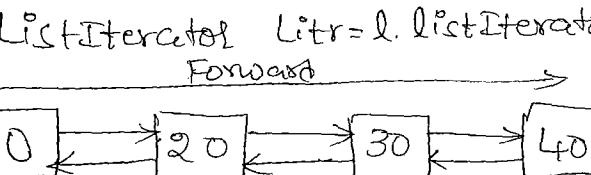
```
ListIterator Litr = l.listIterator();
```

Forward



Litr

just
before the
first element



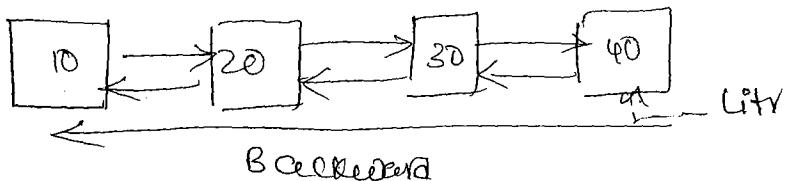
```
while (Litr.hasNext())
```

{

```
Object obj = litr.next();
```

```
Sop(obj); // 10 20 30 40
```

}



```

    int size;
    while(litr.hasNext())
    {
        Object obj = litr.previous(); //④
        Integer i0 = (Integer) obj; //⑤
        int x = i0.intValue(); //⑥
        System.out.println(x); // 40 30 20 10
        sum += x;
    }
}

```

System.out.println(sum); // 100

Ques :- What are the different methods used for retrieving the data from 1-D CFW variables?

Ans :- We've 4 methods to retrieve the data from 1-D CFW variable. They are

1. public Iterator iterator()
2. public Object[] toArray()
3. public Object get(int)
4. public ListIterator listIterator()

ListIterator :-

→ It is one of the pre-defined sub interface of Iterator present in java.util.*

→ The purpose of ListIterator interface object is that to retrieve the data from any 1-D CFW variable in both Forward & Backward direction.

→ Like Iterator interface object ListIterator @ interface object also by default pointing to just before the first element.

Methods :-

- | | |
|-----------------------------|---------------------------------|
| 1. public boolean hasNext() | 3. public boolean hasPrevious() |
| 2. public Object next() | 4. public Object previous() |

Inherited from Iterator

Method-3 returns true provided it has previous elements (330) ○

Otherwise returns false. Method-4 is used for obtaining previous element provided method-3 must return true. ○

Methods in Java.util.Set :-

WKT Set is the sub-interface of Collection so that all the methods of Collection are inherited into Set. ○

"Set interface doesn't contain any special methods except Collection interface methods" ○

Eventhough the methods of Collection & Set are same, Collection methods are defined in some other pre-defined class in such a way that Duplicates are allowed. Whereas Set methods are defined in some other pre-defined class in such a way that unique elements are allowed. ○

In Otherwords eventhough the methods of collection & set interfaces are same, whose implementations are different in different pre-defined classes for satisfying their properties. ○

Methods in Java.util.SortedSet :-

WKT SortedSet is the sub-interface of Set interface so that all methods of Set are inherited into SortedSet. ○

As a part of JDK15 & further version onwards we've the following special methods. ○

1. public Object first()

↑ Target

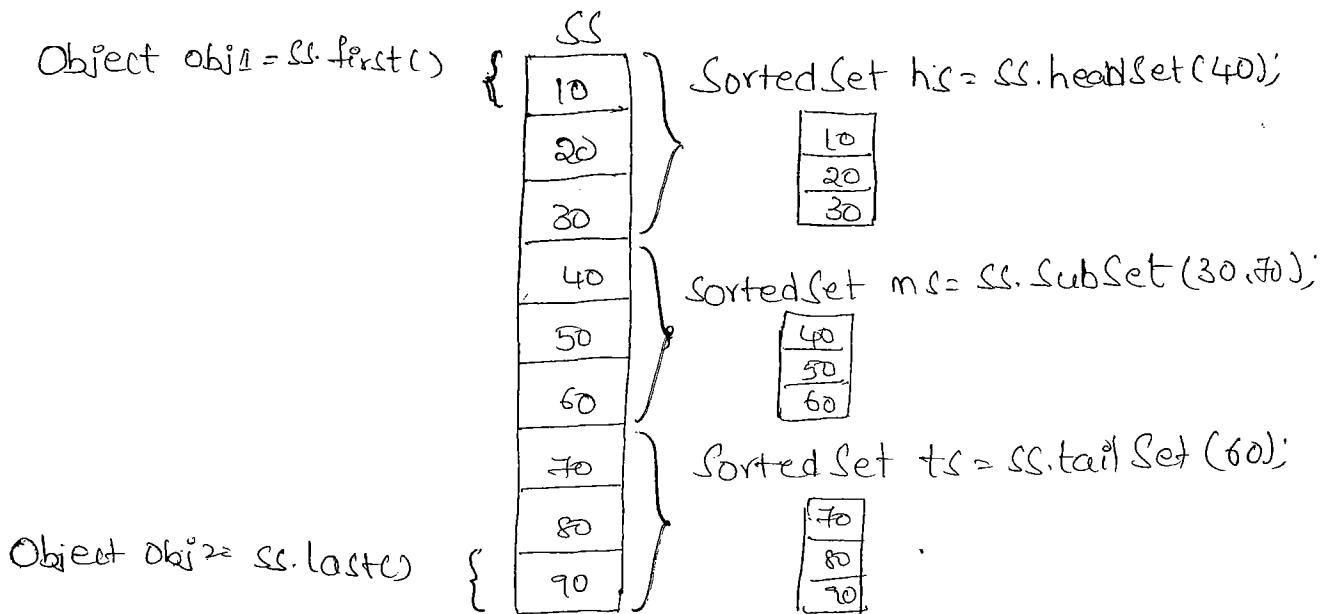
2. public Object last()

3. public SortedSet headSet(Object obj) → $x_i < obj$

4. public SortedSet subSet(Object obj1, Object obj2) $obj1 < x_i < obj2$

5. public SortedSet tailSet(Object obj) → $x_i > obj$

- (33)
- methods - 1 & 2 are used for obtaining 1st & last elements of Sorted Set
 - Method 3 is used for obtaining few top most values, (x_i^*) which are less than target object obj i.e., $x_i^* < \text{obj}^*$
 - Method - 4 is used for obtaining few middle values (x_i^*) which are greater than target Object obj1 & less than target Object obj2 i.e., $\text{Obj1} \leq x_i^* < \text{Obj2}$
 - Method - 5 is used for obtaining few bottom most values (x_i^*) which are greater than target Object obj i.e., $x_i^* > \text{obj}^*$



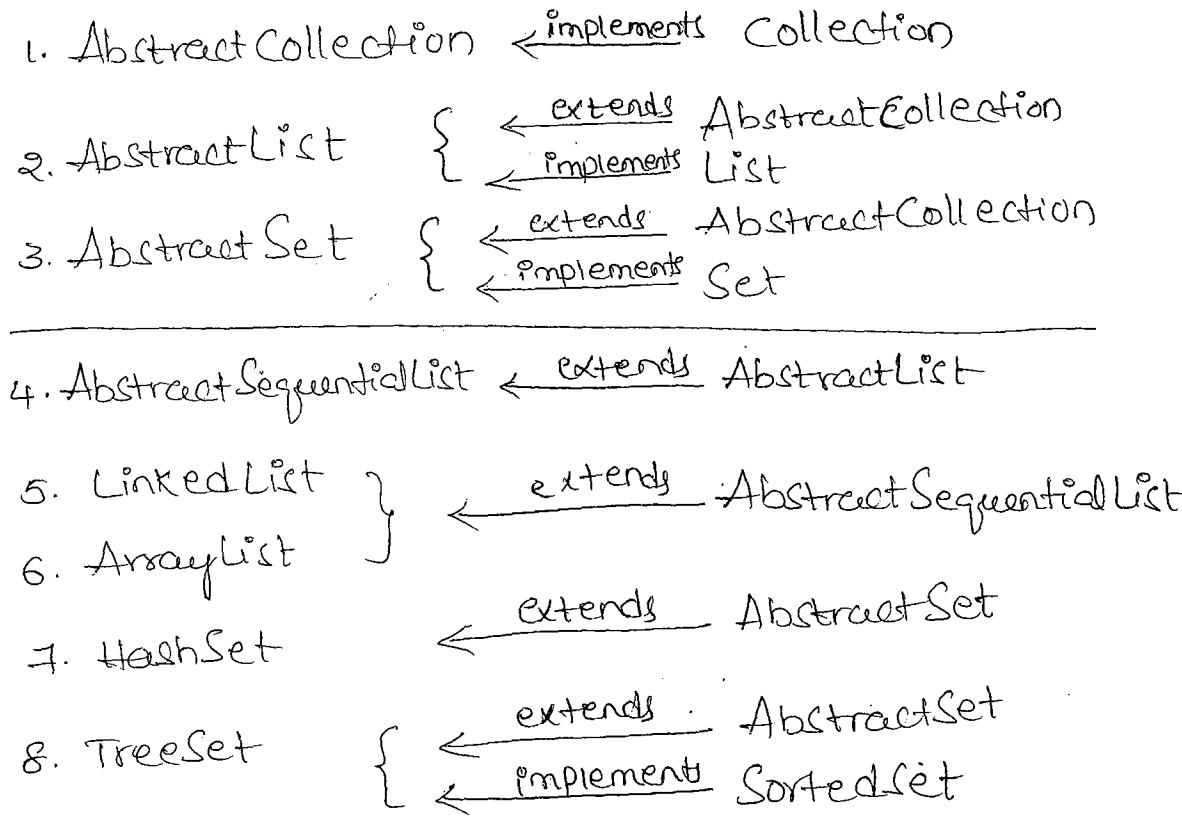
I-D CFW classes

- These classes contains defn for those abstract methods which are inherited from HD CFW interfaces.
- The following table gives I-D CFW interface name, corresponding I-D CFW class name & their hierarchy.

I-D CFW Intf name

1. Collection
2. List
3. Set
4. Sorted Set

I-D CFM class Name



Hierarchy

Q 159

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In the above table the classes 1, 2, 3 & 4 are belongs to Pre-defined I-D CFN abstract class & they are reserved by SUN MS developer for the future innovations in I-D CFN Programming. Since these are abstract we can't create their objects directly & there is no direct usage of these classes.

The classes 5, 6, 7 & 8 are belongs to I-D CFN concrete classes & we use in our real time applications for meeting with the current industry requirements.

NOTE: As a part of CFN (any topic of Java) we've 3 types of layers they are

- a, Interfaces layer
- b, Abstract classes layer
- c, Concrete classes layer

LinkedList

→ LinkedList is one of the concept of data structures.

→ The advantages of LinkedList over arrays concept are

* LinkedList allows to organize homogeneous & heterogeneous values.

* LinkedList provides dynamic size

* LinkedList provides dynamic inserting operations (we can insert an element either in the begining or in the middle or in the last)

* LinkedList concept is by default belongs to Serializable.

To get the above advantages of LinkedList, SUN MS developers provides a predefined class called java.util.LinkedList

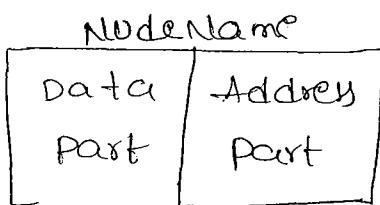
Programmatically, getting the advantages of LinkedList is not but create an object of LinkedList class

Ex:-

LinkedList ll = new LinkedList();

Here, ll is called CFM variable

In LinkedList data is organizing in the form of nodes.
Node contains 2 parts & whose structure is given below.



Here node name represents object name of LinkedList class. Data part represents type of data being stored. Address part represents address of next node. & address part of last node contains null which indicates end of the LinkedList.

Ex:- Store the values 10, 20, 30, 40, 50 in LinkedList

ll.add(10);

ll.add(20);

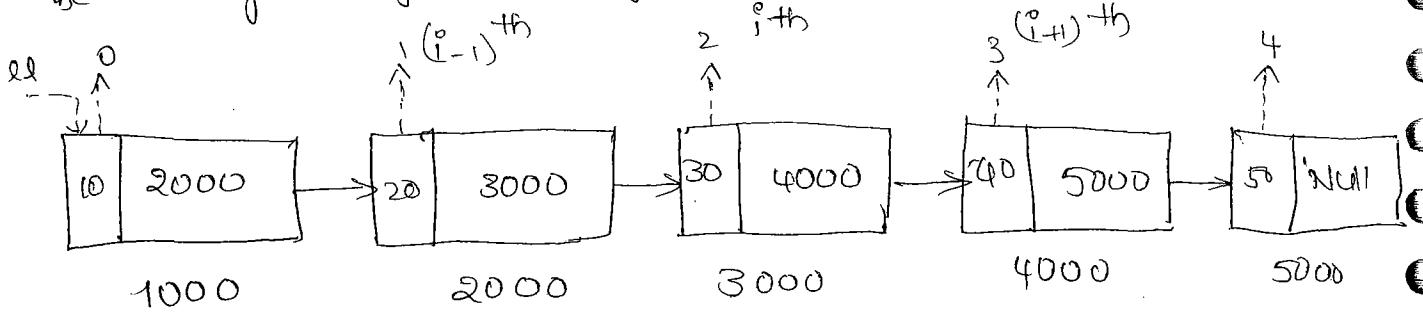
ll.add(30);

ll.add(40);

ll.add(50);

The above elements after adding to LinkedList object

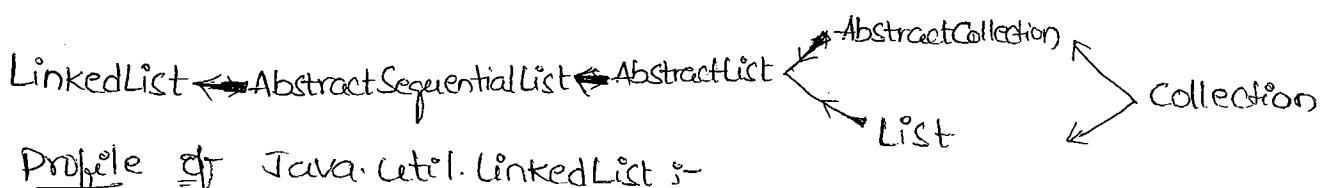
the memory management diagram is



Data organizing data in LL :-

The data organized in linkedList in such a way that address of i^{th} node stored in address part of $(i-1)^{th}$ node, address part of i^{th} node contains address of $(i+1)^{th}$ part & address part of last node contains null which indicates end of the LinkedList.

ISLL15
The hierarchy of Linked List is shown below.



Profile of Java.util.LinkedList :-

Constructors :-

1. `LinkedList()`

2. `LinkedList(int)`

Instance methods :-

3. `public void addFirst(Object)`

4. `public void addLast(Object)`

5. `public Object removeFirst()`

6. `public Object removeLast()`

7. `public Object getFirst()`

8. `public Object getLast()`

→ Constructor-1 is used for creating an object of `LinkedList` class without specifying no. of nodes to created.

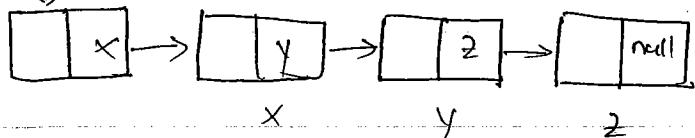
Ex:- `LinkedList ll = new LinkedList();`

→ Constructor-2 is used for creating an object of `LinkedList` by specifying the no. of nodes to be created.

→ `LinkedList(int n)` is its implementation.

Data Part	Address Part
-----------	--------------

ll



→ Methods - 3 & 4 are used for adding the elements in the begining & ending of the LinkedList respectively

Ex:- ll.addFirst(10);

(or) first element position

ll.add(6, 10);

ll.addLast(50);

(or) last element position.

ll.add(ll.size(), 50);

→ Methods - 5 & 6 are used for removing the 1st & last elements of the LinkedList respectively.

Ex:-

Object Fobj = ll.removeFirst();

(or)

Object Fobj = ll.removeElementAt(0);

1st element position

Object Lobj = ll.removeLast();

(or)

Object Lobj = ll.removeElementAt(ll.size() - 1);

last element position

→ Methods - 7 & 8 are used for obtaining 1st & last elements of LinkedList.

Ex:-

Object Fobj = ll.getFirst();

(or)

Object Fobj = ll.get(0);

1st element position

Object Lobj = ll.getLast();

(or)

Object Lobj = ll.get(ll.size() - 1);

last element position

* Write a java program which illustrate the concept of LinkedList & perform various operations

// LL.java

```
import java.util.*;  
class LL  
{  
    public static void main(String []args)
```

LinkedList ll = new LinkedList();

System.out.println("contents of ll = " + ll); // []

System.out.println("size of ll = " + ll.size()); // 0

// Add the elements to ll - 1-D CFW Variable

ll.add(20);

ll.add(30);

ll.add(40);

System.out.println("contents of ll = " + ll); // [20 30 40]

System.out.println("size of ll = " + ll.size()); // 3

// add the elements 10 & 50 at first & last position

ll.add(0, 10);

ll.add(ll.size(), 50);

System.out.println("contents of ll = " + ll); // [10 20 30 40 50]

System.out.println("size of ll = " + ll.size()); // 5

// extract the data from ll

. System.out.print(" = = = = = = = = = = ");

System.out.print(" extract the data from ll - iterator()");

System.out.print(" = = = = = = = = = = ");

int s = 0;

Iterator itr = ll.iterator();

while (itr.hasNext())

{

Object obj = itr.next(); // Step-4

Integer io = (Integer) obj; // Step-5

int x = io.intValue(); // Step-6

SOPC("x");

S = S + x;

}

SOPC("sum-iterator() = " + S);

SOPC(" = = = = = = = = = = = ");

SOPC(" extract the data from ll-ListIterator() - Forward direction");

SOPC(" = = = = = = = = = = ");

ListIterator litr = ll.ListIterator();

while (litr.hasNext())

{

Object obj = litr.next();

SOPC(obj); // 10 20 30 40 50

} // while

SOPC(" = = = = = = = = = = = ");

SOPC(" extract the data from ll-ListIterator() - Backward direction");

SOPC(" = = = = = = = = = = = ");

int S1 = 0;

while (litr.hasPrevious())

{

Object obj = litr.previous();

Integer io = (Integer) obj;

int x = io.intValue();

SOPC(x);

SOP(" sum = ll.iterator() + s1);

SOP(" == == == == == == == == ");

SOP(" extract the data from ll - toArray()");

SOP(" == == == == == == == == == ");

Object obj[] = ll.toArray();

for (int i=0; i<obj.length; i++)

{
SOP(obj[i]);

}

SOP(" == == == == == == == == == ");

SOP(" random data from ll - get()");

SOP(" == == == == == == == == == ");

Object robj = ll.get(2);

SOP(" random element = " + robj); //30

SOP(" == == == == == == == == == ");

}

}

* Write a java program which accept 3 integer values & find the biggest element return all 3 source values along with biggest value.

// Big.java

Package bp;

import java.util.*;

Public class Big

{

int a,b,c;

Public void readValues()

{

Scanner s = new Scanner(System.in);

SOP("Enter First Value");
a = Integer.parseInt(s.nextLine());
SOP("Enter Second value");
b = Integer.parseInt(s.nextLine());
SOP("Enter Third Value");
c = Integer.parseInt(s.nextLine());
}

Public linkedList ll = new findBig()
{
linkedList ll = new linkedList();
if(a == b) & & (b == c) & & (c == a))
{
ll.add("ALL VALUES ARE SAME");
}
else
{
int big=a;
if(b > big)
{
big=b;
}
if(c > big)
{
big=c;
}
}

// Send the values a,b,c & big

ll.add("Val of a = "+a);
ll.add("Val of b = "+b);

```

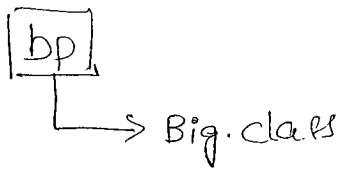
    ll.add("val of c = "+c);
    ll.add("biggest = "+big);
}
else
    return ll;
}

public void disp(LinkedList ll)
{
    System.out.println("-----");
    System.out.println("Result");
    System.out.println("-----");
    Iterator itr=ll.iterator();
    while(itr.hasNext())
    {
        Object obj=itr.next();
        System.out.println(obj);
    }
}
}

```

Compile the above program

java -d. Big.java



A method of Java is not only returning CFW object but also taking CFW object.

* Write a java main program which makes use of bp.Big class for finding biggest of 3 numbers.

|| BigDemo.java

import java.util.*;

import bp.Big;

class BigDemo

{

 public static void main(String [] args)

{

 Big bo = new Big();

 bo.readValue();

 LinkedList ll = bo.findBig();

 bo.disp(ll);

}

}

Limitations of LinkedList :-

- LinkedList based applications takes more memory space
- LinkedList based applications takes more execution time
- The overall performance of LinkedList is less. (The reason behind these limitations is that data part & address part of a node of LinkedList is explicitly created in heap memory which will take more memory space. & to retrieve the data from heap memory takes more time)

To overcome these limitations we've another pre-defined

class called java.util.ArrayList.

NOTE:- If we store any values in Allocative memory then

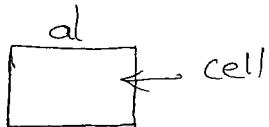
they takes negligible amount of memory space. If we retrieving it takes negligible

ArrayList :-

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- It is one of the bottom most concrete sub classes in I-O API.
- ArrayList class developed by Sun MS Developers by following the implementation of Associative memory.
- In ArrayList data is organizing in the form of cells. Cell values stored in heap memory & cell addresses are stored in associative memory.
- Creating an ArrayList is nothing but creating an object of ArrayList class.

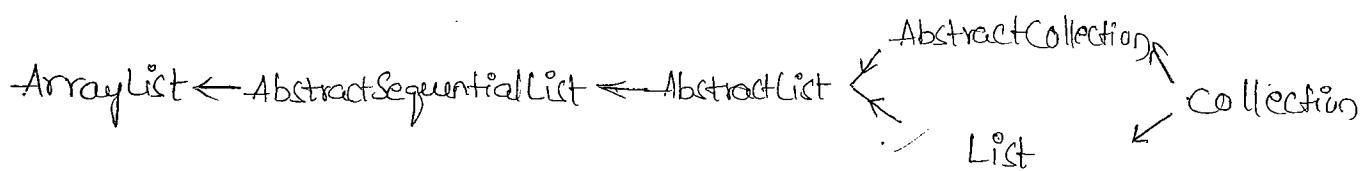
Ex:- ArrayList al = new ArrayList();



Advantages of ArrayList over LinkedList :-

1. ArrayList based applications takes less memory space.
2. ArrayList based applications takes less execution time.
3. Overall performance of ArrayList is more.

The hierarchy of ArrayList is shown below.



Profile of java.util.ArrayList :- Constructor :-

ArrayList():

This constructor is used for creating an object of ArrayList class.

NOTE :- If we come across LinkedList in our maintenance projects it must be replaced by ArrayList class.

* WAP which illustrate Data transfer Object (DTO), Data Access Object (DAO).

// EmpDTO.java

```
package cp;
import java.util.*;
public class EmpDTO
{
    public ArrayList empDTO()
    {
        Scanner s = new Scanner(System.in);
        System.out.println("Enter Emp Number:");
        int eno = Integer.parseInt(s.nextLine());
        System.out.println("Enter Emp Name:");
        String name = s.nextLine();
        System.out.println("Enter Emp Sal:");
        int sal = Integer.parseInt(s.nextLine());
        System.out.println("Enter Emp Desig:");
        String des = s.nextLine();
        // return all the emp values
        ArrayList al = new ArrayList();
        al.add("Emp Number = " + eno);
        al.add("Emp Name = " + name);
        al.add("Emp Sal = " + sal);
        al.add("Emp Desig = " + des);
        return al;
    }
}
```

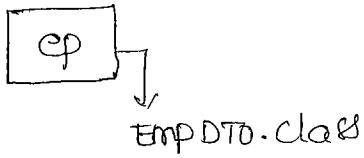
```

    public void dispDTO(ArrayList al)
    {
        System.out.println("Emp DTO Values");
        System.out.println();
        Object obj[] = al.toArray();
        for(int i=0; i<obj.length; i++)
        {
            System.out.println(obj[i]);
        }
    }
}

```

Compile the above program

javac -d . EmpDTO.java



* What main program which makes use of cp.EmpDTO for obtaining all the emp values at once & reading all values at once.

// EmpDTO Demo

```

import ep.EmpDTO;
import java.util.ArrayList;
class EmpDTODemo
{
    public static void main(String [] args)
    {
        EmpDTO eo=new EmpDTO();
        ArrayList al=eo.empDTO();
        eo.dispDTO(al);
    }
}

```

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HashSet

TreeSet

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HashSet

1. An object of HashSet never allows us to add duplicates.
2. An object of HashSet organizes the data in the form of Hash table by following Hashing mechanism.
3. We can't determine in which order HashSet class object display the data i.e., undetermined form bcz SUN MS Developers did not disclose which type of Hashing mechanism followed by SUN MS Dev at the time of implementation of HashSet.
4. On HashSet class object the operations like insertion, deletion, modification & Lookup operations takes more time.
5. Retrieving the data from HashSet takes more time.
6. Creating HashSet class is nothing but creating an object of HashSet class
7. The hierarchy of HashSet is shown below



TreeSet

1. An object of TreeSet never allows us to add duplicates.

2. An object of TreeSet organizes the data in the form of nodes by following Binary Trees concept.

3. An object of TreeSet always gives in sorted order.

4. On TreeSet the operations like insertion, deletion, modification and Lookup takes less time.

5. Retrieving the data from TreeSet class takes less time.

6. Creating TreeSet is nothing but creating an object of TreeSet class

7. The hierarchy of TreeSet is shown below



Q) * WAP which illustrate the concept of HashSet & TreeSet Operations

⇒ // hsts.java

import java.util.*;

class hsts

{

public static void main()

{

// HashSet hs=new HashSet(); it gives undetermined order
of obj.

TreeSet hs=new TreeSet();

Sop(" contents of hs = "+hs); // []

Sop(" size of hs = "+hs.size()); // 10

hs.add(10);

hs.add(100);

hs.add(1);

hs.add(90);

hs.add(90); // executed but not added to hs

Sop(" contents in hs = "+hs); // [---]

Sop(" size of hs = "+hs.size()); // 4

// extract data from hs

Sop(" extracting the data from hs = iterator");

Iterator itr=hs.iterator();

while(itr.hasNext())

{

Object obj=itr.next();

Sop(obj);

}

Sop(" extracting data from hs.toArray");

Object obj[] = hs.toArray();

for(int i=obj.length-1; i>=0; i--)

{

Sop(obj[i]);

}

Sop(" random element = "+obj[2]);

* Here ListIterator & get
are not used bcoz
they belongs to
List interface
only

*WAP which will accept 'N' integer values & print them in Ascending order, descending order, highest & lowest element.

// Sortop.java

Package Sp;

import java.util.*;

Public class Sortop

{

private TreeSet ts=new TreeSet();

Public TreeSet readValues()

{

Scanner s= new Scanner(System.in);

Sop("Enter how many values u want to sort");

int n=Integer.parseInt(s.nextLine());

// Accept n values from keyboard

for(int i=0; i<n; i++)

{

Sop(" Enter "+(i+1)+" value");

int v=Integer.parseInt(s.nextLine());

ts.add(v);

}

return ts;

}

Public void printDiffOrder(TreeSet ts)

{

Sop(" _____ ");

Sop("Asc Order");

Sop(" _____ ");

Object obj[]= ts.toArray();

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```

for(int i=0; i<obj.length; i++)
{
    System.out.println(obj[i]);
}
System.out.println(" ");
System.out.println(" Desc order");
System.out.println(" ");
for(int i=Obj.length-1; i>=0; i--)
{
    System.out.println(Obj[i]);
}
System.out.println("min val = "+obj[0]);
System.out.println("max val = "+obj[Obj.length-1]);
}

```

}// Sortop - Common BLC

Compile the above program

javac -d . Sortop.java



* KJAMP which makes use of sp.Sortop class

// SortDemo.java

```

import sp.SortOP;
import java.util.*;
class SortDemo
{
    public static void main (String [] args)
    {
        Sortop so=new Sortop();
        TreeSet ts = so.readValues();
        so.printDiffOrders(ts);
    }
}

```

// OR
new Sortop().printDiffOrders(new SortOP().readValues());

}

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2-D CFM

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→ In 2-D CFM the data is organizing in the form of (key, value)

→ In (K,V) Value of key represents unique

↳ value of value represents may/may not be unique
(i.e., duplicates are allowed)

Ex:- Organize student no's & names

Student ← 2-D CFM	
Name of the Key	Variable Name
→ Stno	→ Name
10	Sathya
11	Sathya
12	JG
13	Ravi

values of key → Values of value

Ex:- Organize account no's & balances

deposit ← 2-D CFM	
Name of the Key	Variable
→ ACNO	→ Name of the value
10	1.5
20	2.5
30	1.5

values of key → Values of value

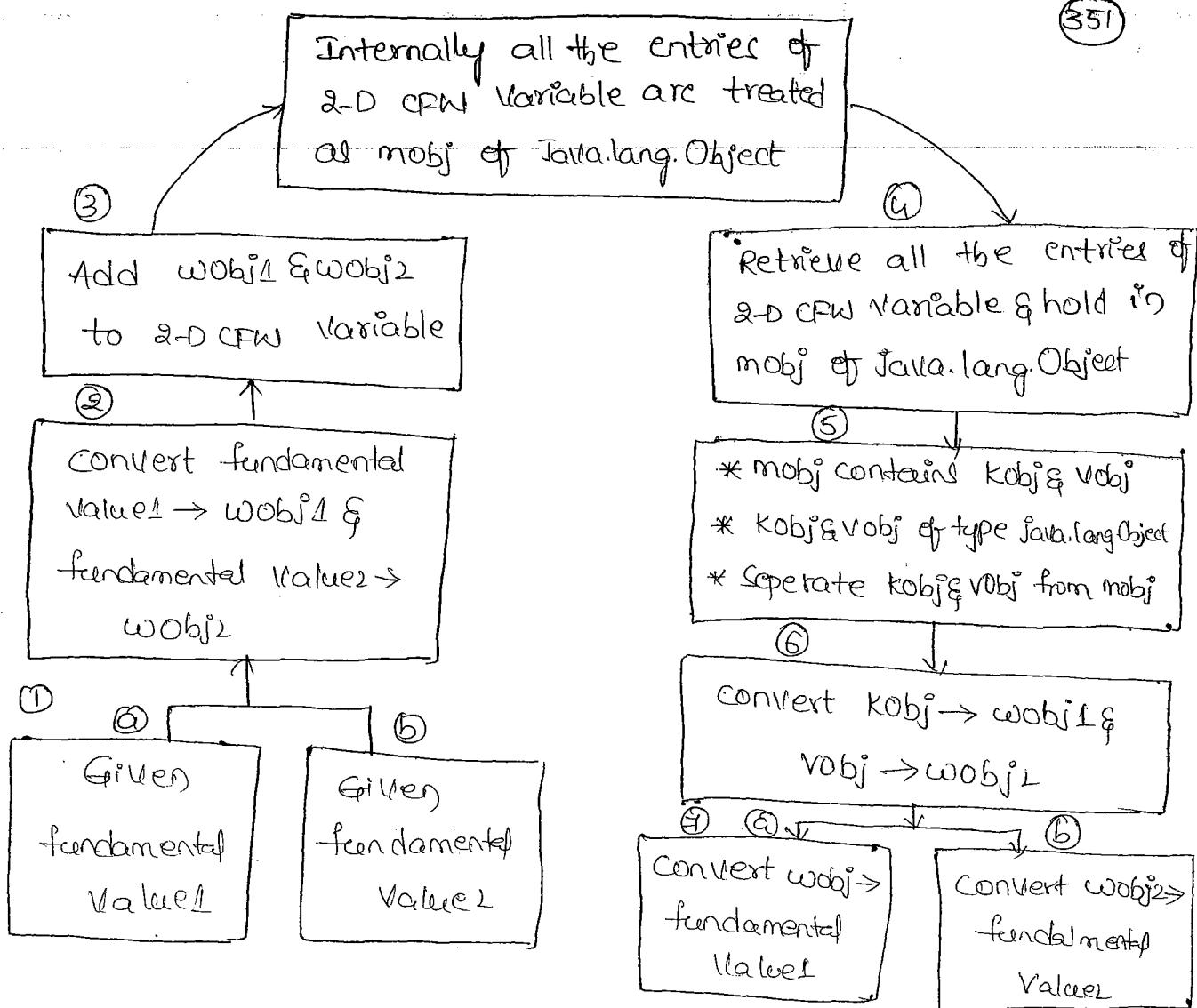
2-D CFM process

This process contains 2 phases. They are

1. grouping/ assembling phase

2. Un grouping/ de assembling phase

The following diagram gives sequence of steps for both grouping



In the above diagram ① ② ③ steps are used for grouping phase
④ ⑤ ⑥ ⑦ are used for ungrouping phase.

To deal with 2-D CFN programming we need to learn
2-D CFN interfaces & corresponding classes. & they are present
in `Java.util.*` package

2-D CFN / ~~Inter~~ double / map Interface

We've 3 types of interfaces. They are

1. `Java.util.Map`
2. `Java.util.Map.Entry`
3. `Java.util.SortedMap`

Java.util.Map :-

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- It is one of the top most pre-defined interface present in 2-D CFM
- Map interface object organizes the data in the form of (K,V)
- Map interface object displays the data in random order. (which is nothing but whatever the order we add in the same order the data will be displayed.)

Profile of Java.util.Map :-

This meth

1. Public int size():-

This method is used for finding the no. of entries present in 2-D CFM variable.

2. Public boolean isEmpty():-

It returns true provided 2-D CFM variable is empty otherwise it returns false.

3. Public void put(Object, Object) :-

This method is used for inserting (K,V) in 2-D CFM variable & it can also be used for modifying the existing value of 2-D CFM variable with new value.

Ex:-

m.put(10, 1.5f);
 m.put(20, 2.5f);
 m.put(30, 1.5f);

$m \leftarrow$ 2-D CFM variable

10	1.5
20	2.5
30	1.5

sop(m); // { (10=1.5), (20=2.5), (30=1.5) }

m.put(10, 9.5f); } modified entry

10	9.5
20	2.5
30	1.5

sop(m); // { (10=9.5), (20=2.5), (30=1.5) }

4. Public Object get(Object):-

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This method is used for obtaining the value of Value by passing the value of Key.

Ex:- Get the balance of A/c No:-10

Object bal = m.get(10); ↳ found
[9.5]

SOP(bal); // 9.5

Object bal1 = m.get(100); ↳ not found
[Null]
SOP(bal1); // Null

5. Public Set keySet():-

This method is used for obtaining the set of keys from 2-D CFM variable. Pass these set of keys to get() & obtain values of Value.

Ex:-
SOP(m); // { (10=1.5), (20=2.5), (30=3.5) }

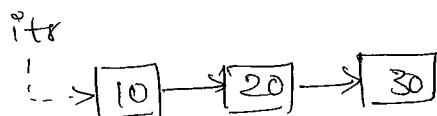
Set s = m.keySet();

// s = [10, 20, 30]

m < 2-D CFM variable	
10	1.5
20	2.5
30	3.5

Part II: KeySet() → Set → Iterator()

Iterator itr = s.iterator();



while (itr.hasNext())

{

Object kobj = itr.next();

Object vobj = m.get(kobj);

Integer iobj = (Integer) kobj;

Float fobj = (Float) vobj;

```

int acno = i0.intValue();
float bal = f0.floatValue();
SOP(bal + " is the bal of " + acno);
}

```

Ex 2 :-

```
SOP(m); // { (10=1.5), (20=2.5), (30=1.5) }
```

```
Set s = m.entrySet();
// S = [10 20 30]
```

Point-2 : `keySet() → Set → toArray()`

Object kobj[] = s.toArray();

```
for(int i=0; i < kobj.length; i++)
```

{

Object vobj = m.get(kobj[i]);

Integer i0 = (Integer) kobj[i];

Float f0 = (Float) vobj;

int acno = i0.intValue();

float bal = f0.floatValue();

SOP(bal + " is the bal of " + acno);

m → 2-D CFW

10	1.5
20	2.5
30	1.5

variable

kobj

10	0
20	1
30	2

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6. public Set entrySet() :-

This method is used for retrieving/extracting all the entries

of 2-D CFW variable & holding in the object of Set.

```
Ex 3 SOP(m); // { (10=1.5), (20=2.5), (30=1.5) }
```

```
Set s = m.entrySet();
```

```
// S = [(10=1.5), (20=2.5), (30=1.5)];
```

m → 2-D CFW

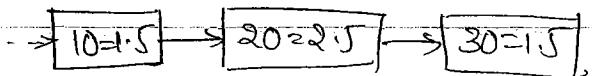
10	1.5
20	2.5
30	1.5

variable

Entries `entrySet() → Set → iterator()`

Iterator itr = s.iterator();

itr



while(itr.hasNext())

{

Object mobj = itr.next(); //④

Map.Entry me = (Map.Entry) mobj; → Object type casting

Object kobj = me.getKey(); } //⑤

Object vobj = me.getValue(); } //⑥

Integer io = (Integer) kobj; } //⑦

Float fo = (Float) vobj; } //⑧

int acno = io.intValue(); } //⑨

float bal = fo.floatValue(); } //⑩

}

Ex 4 :- sop(m); // { (10=1.5), (20=2.5), (30=1.5) }

Set s = m.entrySet();

// s = [(10=1.5), (20=2.5), (30=1.5)]

m → 2-D CPP

variable

10	1.5
20	2.5
30	1.5

Point :- entrySet() → Set → toArray()

Object mobj[] = s.toArray();

for (int i = 0; i < mobj.length(); i++)

{

Map.Entry me = (Map.Entry) mobj[i]; → Object type casting

Object kobj = me.getKey(); } //⑤

Object vobj = me.getValue(); } //⑥

Integer io = (Integer) kobj; } //⑦

Float fo = (Float) vobj; } //⑧

int acno = io.intValue(); } //⑨

mobj	
10=1.5	0
20=2.5	1
30=1.5	2

(356)

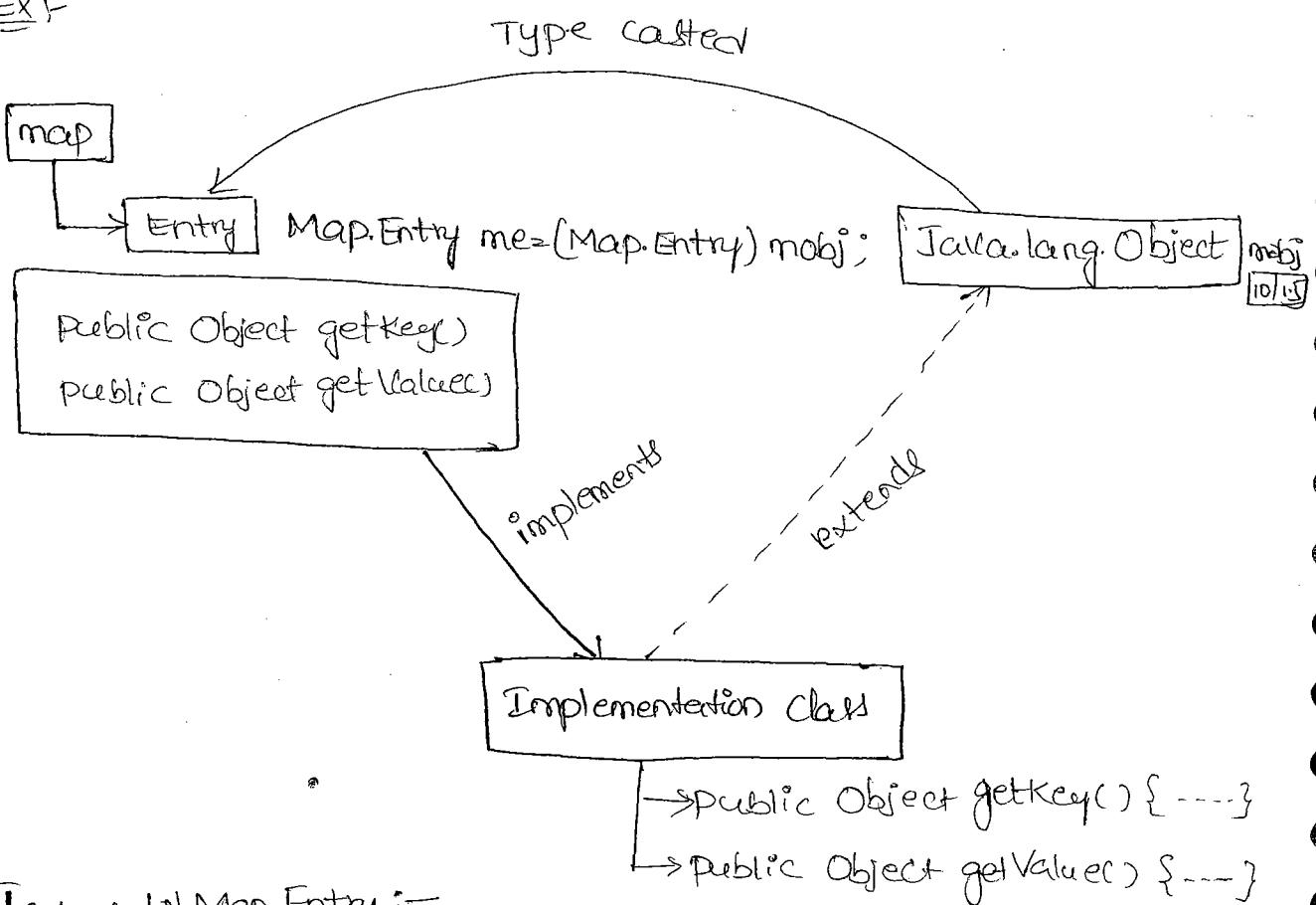
In the above examples the type of Object typecasting is that
Object of java.lang.Object is typecasted to interface object
(Map.Entry).

Formulae

(Object to interface typecasting)

An object of java.lang.Object which is super class of implementation class of super interface is typecasted to object of Super interface of implementation class which is the sub class of java.lang.Object.

Ex:-



Java.util.Map.Entry :-

→ In Map.Entry, Entry is one of the nested/inner interface & Map is one of outer interface.

→ The purpose of Map.Entry is that to separate Key Value & value or value from any 2-D CFW variable.

Methods :-

1. Public Object getKey()
2. Public Object getValue()

The above two methods are used for separating value of key & value of value from any 2-D CFD variable.

Java.util.SortedMap :-

→ It is one of the sub interface of Map so that all the methods of Map are inherited into SortedMap.

→ SortedMap interface object also organizes the data in the form of (Key, Value).

→ SortedMap interface object displays the data in sorted order based on the value of key.

Methods :-

1. Public Object first()
2. Public Object last()
3. Public SortedMap headMap(Object kobj) → $x_i < kobj$
4. Public SortedMap subMap(Object kobj₁, Object kobj₂) → $kobj_1 \leq x_i \leq kobj_2$
5. Public SortedMap tailMap(Object kobj) → $x_i > kobj$

For more explanation see the methods of SortedSet

Object fmobj = sm.first();

$\boxed{10, 1.5}$

10	1.5
20	2.5
30	1.5

SortedMap hm = sm.headMap(40);

10	1.5
20	2.5
30	1.5

SortedMap mm = sm.subMap(30, 70);

40	2.5
50	2.8
60	1.9

SortedMap tm = sm.tailMap(60);

70	8.5
80	1.5

Object lmobj = sm.last();

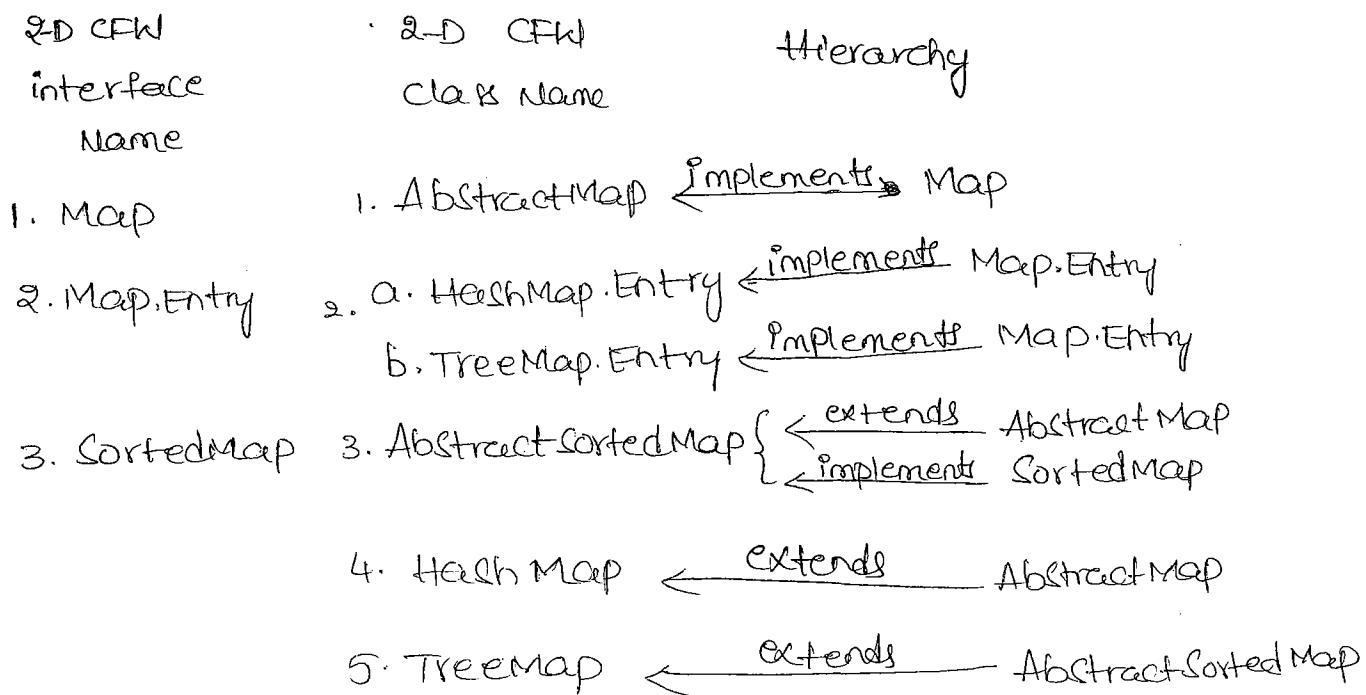
$\boxed{90, 9.5}$

2-D CFW classes / double/ Map classes :-

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These class contains implementation for the abstract methods of 2-D CFW interfaces.

The following table gives 2-D CFW interface name corresponding class name & their hierarchy.



In the above hierarchy chart the classes ① & ③ are belongs to pre defined abstract classes in 2-D CFW & they reserved by sun MC developer for future innovations in CFW & we may not be using directly in our real world applications.

The classes ④ & ⑤ are two bottom most pre defined concrete classes in 2-D CFW & we use them in our application.

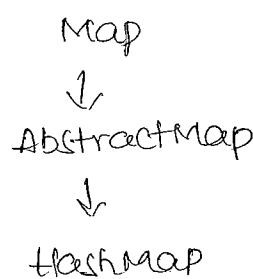
HashMap & TreeMap

Q) * Differences b/w HashMap & TreeMap :-

(35)

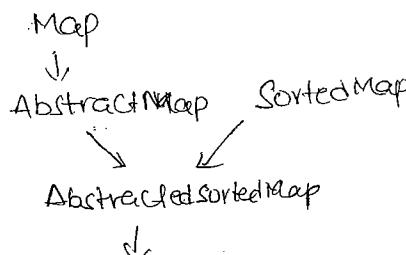
HashMap

1. An object of HashMap never allows us to add duplicates.
2. An object of HashMap organizes the data in the form of Hash table by following Hashing mechanism.
3. We can't determine in which order HashMap class object display the data i.e., undetermined form bcoz Sun MS Dev didn't disclose which type of Hashing mechanism followed by Hashing sunMSDev at the time of implementation of HashMap.
4. On HashMap class object the operations like insertion, deletion, modification & lookup operations takes more time.
5. Retrieving the data from HashMap takes more time.
6. Creating HashMap class is ntng but creating an object of HashMap class.
7. The hierarchy of HashMap is shown in below.



TreeMap

1. An object of TreeMap never allows us to add duplicates.
2. An object of TreeMap organizes the data in the form of nodes by following Binary Tree concept.
3. An object of TreeMap always gives in sorted order.
4. On TreeMap the operations like insertion, deletion, modification & lookup operations takes less time.
5. Retrieving the data from TreeMap takes less time.
6. Creating TreeMap is ntng but creating an object of TreeMap class.
7. The hierarchy of TreeMap is shown in below.



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* W4JP which illustrate the concept of HashMap & TreeMap.

//hmtn.java

```
import java.util.*;  
class hmtn  
{  
    public static void main(String [] args)  
    {  
        //HashMap hm=new HashMap();  
        TreeMap tm=new TreeMap();  
        System.out.println("contents of tm = "+tm); // {}  
        System.out.println("size of tm = "+tm.size()); // 0  
    }  
}
```

// add the data to tm

```
tm.put(100, 2.4f);  
tm.put(1, 2.5f);  
tm.put(10, 2.4f);  
tm.put(90, 2.4f);  
tm.put(90, 12.4f); // executed but not added & considered  
// as modified entry  
System.out.println("contents of tm = "+tm); // {}  
System.out.println("size of tm = "+tm.size()); // 4
```

// extract the data from 2-D CFN variable

System.out.println("Extract the data from tm - keySet() - Set - Iterator()
- EX1 - Seeeee in the book");

System.out.println(" ");

Set s=tm.keySet();

Iterator i=s.iterator();

for(i;i.hasNext();)

Object kobj = itr.next();
Object vobj = hm.get(kobj);

Integer i0 = (Integer) kobj;

Float fo = (Float) vobj;

int acno = i0.intValue();

float bal = fo.floatValue();

Sop("bal + " + is the bal of " + acno);

} // for

Sop(" _____ ");

Sop(" Extract the data from hm.entrySet() - Set.toArray()")

Ex4 - seeeee in the book");

Sop(" _____ ");

Set s1 = hm.entrySet();

Object mobj[] = s1.toArray();

for (int i=0; i < mobj.length; i++)

{

Map.Entry me = (Map.Entry) mobj[i];

Object kobj = me.getKey();

Object vobj = me.getValue();

Integer i0 = (Integer) kobj;

Float fo = (Float) vobj;

int acno = i0.intValue();

float bal = fo.floatValue();

Sop("bal + " → " + acno);

}

Sop(" _____ ");

}

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* WIAJP which will implement phone book operations such as adding no. of contacts, search for a contact no, display the contacts etc.

// PhoneBook.java

```
Package Pb;  
import java.util.*;  
  
Public class PhoneBook  
{  
    private Scanner s=new Scanner(System.in);  
    private TreeMap Pnb=new TreeMap();  
  
    Public void CreatePhoneBook()  
{  
        SOPC("Enter How many contacts");  
        int noc=Integer.parseInt(s.nextLine());  
        for(int i=0; i<noc; i++)  
        {  
            accept individual contacts(cname, phno)  
            SOPC("Enter " + (i+1) + " contact details");  
            SOPC(" Enter contact Name");  
            String cname=s.nextLine();  
            SOPC(" Enter contact number");  
            int cn0=Integer.parseInt(s.nextLine());  
            Pnb.put(cname, cn0);  
            SOPC(" ");  
        } //for  
    } //CreatePhoneBook()
```

```

public void searchPhoneBook()
{
    System.out.print("Enter contact name:");
    String cname = sc.nextLine();
    Object phno = phb.get(cname);
    System.out.println("_____");
    if (phno != null)
    {
        System.out.println(phno + " is the contact number of " + cname);
    }
    else
    {
        System.out.println(cname + " related contacts does not exists.");
    }
}

```

```

} // search phonebook()

public void dispPhoneBook()
{
    Set s = phb.entrySet();
    Iterator itr = s.iterator();
    while (true)
    {
        System.out.println("_____");
        System.out.println(" contact name | contact number");
        System.out.println("_____");
        while (itr.hasNext())
        {
            Object mobj = itr.next();
            Map.Entry me = (Map.Entry) mobj;
            Object cname = me.getKey();
            Object phno = me.getValue();
            System.out.println(cname + " | " + phno);
        }
    }
}

```

SOPC("cname + " + phno);

{ // white

SOPC(" " + ");

{ // dispPhoneBook()

{ // phoneBook - common BLC

compile the above program - javac -d . PhoneBook.java

* WAP main program which makes use of

Pb.PhoneBook class

// PhoneBookDemo.java

import Pb.Phonebook;

class PhoneBookDemo

{

public static void main(String [] args)

{

PhoneBook p = new PhoneBook();

p.CreatePhoneBook();

p.SearchPhoneBook();

p.dispPhoneBook();

}

}

* WAP which will accept no. of states & capitals & organize them in a single unit. Accept the state name & find its capital.

// StateCap.java

package SC;

import java.util.*;

public class StateCap

{

public void acceptStateCap()



PhoneBook.class

```

TreeMap stc = new TreeMap();
public void acceptStateCreateStateCap()
{
    System.out.println("Enter How many States");
    int nos = Integer.parseInt(s.nextLine());
    // accept individual states (state, cap)
    for(int i=0; i<nos; i++)
    {
        System.out.println("Enter " + (i+1) + " state details");
        System.out.println("Enter State name");
        String State = s.nextLine();
        System.out.println("Enter capital");
        String cap = s.nextLine();
        Stc.put(State, cap);
        System.out.println("-----");
    }
}

```

```

public void acceptStateCap()
{
    System.out.println("Enter State name");
    String State = s.nextLine();
    Object cap = Stc.get(State);
    System.out.println("-----");
    if(cap!=null)
    {
        System.out.println(cap + " is the capital of " + State);
    }
}

```

```

else
{
    SOPC("enter correct capital of " + stateName);
}
SOPC("_____");
} // acceptstatecap
public void dispState()
{
    Set p = sn.entrySet();
    Iterator itr = p.iterator();
    SOPC("_____");
    SOPC(" state (capital)");
    SOPC("_____");
    while (itr.hasNext())
    {
        Object obj = itr.next();
        Map.Entry me = (Map.Entry) obj;
        Object sname = me.getKey();
        Object cap = me.getValue();
        SOPC("capital of " + sname + " is " + cap);
    }
    SOPC("_____");
} // dispState()
} // StateCap

```

compile the above program

javac -d . StateCap.java

sc

statecap.class

① → Main Program

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② //StateDemo.java

```
import SC.StateCap;  
class StateDemo  
{  
    public void main(String []args)  
    {  
        StateCap se = new StateCap();  
        se.createStateCap();  
        se.AcceptStateCap();  
        se.DisplayState();  
    }  
}
```

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Legacy collection Framework

Def:- Renamed form of existing data structures of java is called Legacy CFW.

Differences btw LCFW, NCFW:-

Legacy CFW

1. Renamed form of existing data structures of java is called LCFW.
2. The methods of classes & interfaces of LCFW are belongs to synchronized.
3. LCFW by default provides thread safety results.
4. Indostry is always recommended to use LCFW as a part of non server side apps. (client side apps)

New CFW

1. Revised form of existing data structures of java is called NCFW.
2. The methods of classes & interfaces of NCFW are belongs to synchronized.
3. NCFW by default provides non thread safety results.
4. NCFW is always recommended to use in server side apps (bcz even though NCFW is non synchronized, in built synchronization is provided by server side)

Like NCFW, LCFW also contains 1-D & 2-D CFW's with ~~collection~~ collection of classes & interfaces & they are present in java.util. package. They are

1. Enumeration
2. Vector
3. Stack } 1D CFW
4. Dictionary
5. Hashtable
6. Properties

Enumeration:-

It is one of the pre-defined interface present in java.util.

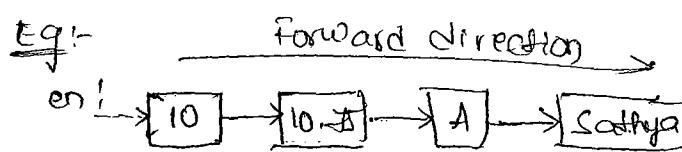
- The purpose of Enumeration interface object is that to extract the data from any LCFW variable in forward direction only.
- The functionality of Enumeration is more or less similar to Iterator interface object but Enumeration info object belongs to synchronized & Iterator info object belongs to non-synchronized.
- Like iterator info object the enumeration interface object also points just before the first element.

Methods :-

1. public boolean hasMoreElements()
2. public Object nextElement()

Method:1 returns true provided it contains more elements.
Otherwise it returns false.

Method:2 is used to obtain next element of any Legacy CFW
provided method:1 returns true.



while(en.hasMoreElements())

{

Object obj = en.nextElement();

Class c = obj.getClass();

↳ class java.lang.Integer & float etc

String cname = c.getName();

↳ Java.lang.Integer

if(cname.equals("java.lang.Integer")):

{

Integer i0 = (Integer) obj;

int x = i0.intValue(); // Dynamic object Typecasting

}

if(cname.equals("java.lang.Float"))

{

Float fo = (Float) obj;

// DOTC

float x = fo.floatValue();

}

} while

Vector:-

It is one of the concrete class in LCFW, the functionality of vector is more or less similar to ArrayList but vector belongs to synchronized & ArrayList belongs to non-synchronized.

→ In ArrayList the data is organized in the form of cell. cell values are stored in heap memory & cell address are stored in associative memory

→ Creating a vector is nothing but creating an object of vector class

Eg:- Vector v = new Vector();



The default capacity of vector class object is 10 cells & default size of vector class object = 0.

Profile of java.util.Vector:-

Constructors:-

1. Vector()
2. Vector(int)

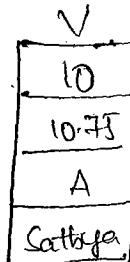
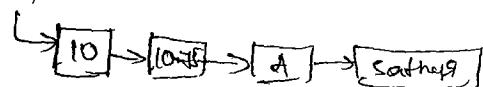
Instance methods :-

3. public int capacity();
4. public int size();
5. public void addElement(Object);
6. public void insertElementAt(int, Object) → add elements at middle
7. public void setElementAt(int, Object) → replaces
8. public Object removeElementAt(int) → removes elements at (position)
9. public void remove(Object) →
10. public void removeAll(); → remove all
11. public Object getElementAt(int) → gives element at (position)
12. public Enumeration elements();

Method-12 is used for retrieving all the elements from vector & forms forward directional chain & it returns an object of Enumeration.

Eg:- System.out.println(v); [10, 10.75, A, Sathya]

Enumeration en = v.elements();



```

    while(en.hasMoreElements())
    {
        Object obj=en.nextElement();
        System.out.println("A "+obj);
    }

```

* WAP which illustrate the concept of operations on Vector along with dynamic object typecasting.

// VectDemo.java

import java.util.*;

class VectDemo

{

public static void main(String [] args)

{

Vector v=new Vector();

System.out.println("Content of v=" +v); // []

System.out.println("Size of v=" +v.size()); // 0

System.out.println("Cap of v=" +v.capacity()); // 0

// add elements to v

v.addElement(10);

v.addElement(10.75);

v.addElement('A');

v.addElement(true);

v.addElement(false);

v.addElement(20.35f);

System.out.println("Content of v=" +v); // [---]

System.out.println("Size of v=" +v.size()); // 4

System.out.println("Cap of v=" +v.capacity()); // 0

// extract the data from v

System.out.println("_____");

System.out.println("Data of v");

```

int is=0;
float fs=0.0f;

Enumeration en=vl.elements();
while(en.hasMoreElements())
{
    Object obj=en.nextElement();
    Sop(obj);
    Class c=obj.getClass();
    String cname=c.getName();
    if(cname.equals("java.lang.Integer"))
    {
        Integer io=(Integer)obj;
        int x=io.intValue();
        is=is+x;
    }
    if(cname.equals("java.lang.Float"))
    {
        Float fo=(Float)obj;
        float x=fo.floatValue();
        fs=fs+x;
    }
}
Sop("Int sum=" + is);
Sop("Float sum=" + fs);
Sop("-----");
}

```

NOTE: Rewrite ArrayList class example [EmpDTO.java] with vector.

NextStack :-

It is one of the distinct feature of data structures & whose realtime implementations are given below.

1. Converting Infix expressions into either prefix (or) postfix expressions at compile time.
2. Evaluation of either prefix (or) postfix expressions at runtime.
3. Evaluation of ordinary method calls (method chaining) & Constructors communication.
4. Evaluation of recursive method calls

To get these internal implementations of stack as a part of java programming we have a pre defined class called `java.util.Stack`. which is one of the sub class of `Vector`.
 → The basic working internal principle of the stack is LIFO
 (Last in First Out - is says the element which is inserted last is that element will be removed first)
 → creating the stack is nothing but creating an object of `Stack` class.

Ex:- `Stack S = new Stack();`

Stack memory management :-

Stack Relative positions	Stack absolute positions	S	Array absolute positions	Array Relative positions
5	4	10	0	1
4	3	20	1	2
3	2	30	2	3
2	1	40	3	4
1	0	50	4	5

SOP(S); // 10 20 30 40 50

Associatively R

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Profile of java.util.Stack:-

Constructors:-

1. Stack()

Instance methods

2. public boolean empty()

3. public void push(Object)

4. public Object pop()

5. public Object peek()

6. public int search(Object)

→ constructor:1 is used for creating an object of Stack class.

→ Method:2 returns true provided stack is empty otherwise it returns false

→ Method:3 is used for inserting an element into the stack.

→ Method:4 is used for removing the top most element.

→ Method:5 is used for extracting top most element from the stack.

→ Method:6 is used for searching an element from the stack, it returns stack relative position (SRP) when an element is found. Otherwise it returns -1 (indicates element not found)

* KATP which illustrates Stack operations.

// StackDemo.java

import java.util.*;

class StackDemo

{
 public static void main(String []args)

{

 Stack s = new Stack();

```
sopc" contents of s = "+s); //[]  
sopc" size of s = "+s.size()); //0  
sopc" is s empty? = "+s.empty()); //true
```

// add the elements to s

```
s.push(10);
```

```
s.push(20);
```

```
s.push(30);
```

```
s.push(40);
```

```
s.push(50);
```

```
sopc" contents of s = "+s); // [10 20 30 40 50]
```

```
sopc" size of s = "+s.size()); //5
```

```
sopc" is s empty? = "+s.empty()); // false
```

// delete top most element

```
sopc" deleted element = "+s.pop()); //50
```

```
sopc" contents of s after pop = "+s); // [10 20 30 40]
```

// extract top most element

```
sopc" top most element = "+s.peek()); //40
```

```
sopc" contents of s after peek = "+s); // [10 20 30 40]
```

// search elements 10 & 100

```
int srp1 = s.search(10);
```

```
sopc" stack refl position of 10 = "+srp1); //4
```

```
int srp2 = s.search(100);
```

```
sopc" stack refl position of 100 = "+srp2); // -1
```

}

}

Dictionary ≈ Map

→ contain pure abstract methods

→ It is one of the legacy2DCFW interface

→ It also having (K,V)

Instance Methods :-

1. public int size()
2. public boolean isEmpty()
3. public void put(Object, Object)
4. public Object get(Object)
5. public void remove(Object)
6. public Enumeration keys()

Same as Map interface
in 2-D CFW

Method 6 is used for extracting set of Keys from 2-D legacy CFW variable & pass those keys to get() obtained the value of value.

Ex:- `sop(D); // {10=1.5}, {20=2.5}, {30=1.5}`

Enumeration en = D.keys();

en
 → [10] → [20] → [30]

while(en.hasMoreElements())

{

Object kobj = en.nextElement();

Object vobj = D.get(kobj);

sop(vobj) " is the val of "+kobj;

}

D → Object of Dictionary						
<table border="1"> <tr> <td>10</td> <td>1.5</td> </tr> <tr> <td>20</td> <td>2.5</td> </tr> <tr> <td>30</td> <td>1.5</td> </tr> </table>	10	1.5	20	2.5	30	1.5
10	1.5					
20	2.5					
30	1.5					

HashTable ≈ HashMap

↓
Syn
not contains
null values

↓
Non-Syn
contains null

→ It is one of the 2-D LCFW subclass of dictionary &

present in `java.util.*`

→ HashTable class object organizes the data in the form of (K,V)

by following Hashing mechanism.

- We can't determine in which order HashTable class object displays the data.
- The functionality of HashTable is more (or) less similar to HashMap but HashTable class object belongs to synchronized & it never allows null values, whereas HashMap class object belongs to non-synchronized & once it allows null values.
※ Rewrite HashMap related program (hmtn.java see previous page) by using HashTable)

Limitations of HashTable :-

1. Hashtable class object is unable to read from properties/resource bundle file.
2. Hashtable class object is unable to read environmental variable names & environmental variable values.
3. Hashtable class object is unable to develop flexible API's.

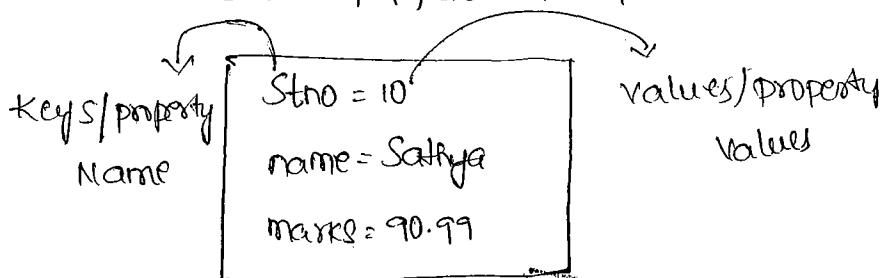
To overcome the above limitations of Hashtable we use another pre-defined class called java.util.Properties.

Property file :-

- A property file is one of the textfile, it must be saved on some filename with an extension .prop (or) .rbf
- A property file organizes the data in the form of (K,V)

Ex:-

student.prop / student.rbf



→ Property files resides in Secondary memory

→ Here we obtain property values by passing property names

→ To read the data from property file, open the property file in read mode with the help of a pre-defined class called FileInputStream stream.

Ex:- Open the student.prop in read mode

```
FileInputStream fis=new FileInputStream("student.prop");
```

Java.util.Properties :-

It is the subclass of HashTable, the advantages of properties over HashTable are.

1. Properties class object allows us to read data from properties file.
2. Properties class object allows us to read environmental variable names & environmental variable values.
3. Properties class object allows us to develop flexible apps.

Profile of Java.util.Properties :-

Constructors:-

1. properties()

Instance Methods:-

2. public void load(FileInputStream)

3. public String getProperty(String)

→ Constructor:1 is used for creating an object of Properties class

Ex:- Properties p=new Properties();

→ Method:2 is used for transferring/loading the content of properties file from secondary memory into the object of Properties class by opening the property file in read mode.

Ex:- FileInputStream fis=new FileInputStream("student.prop");
p.load(fis);

Method : 3 i.e used for obtaining property value by passing  property name.

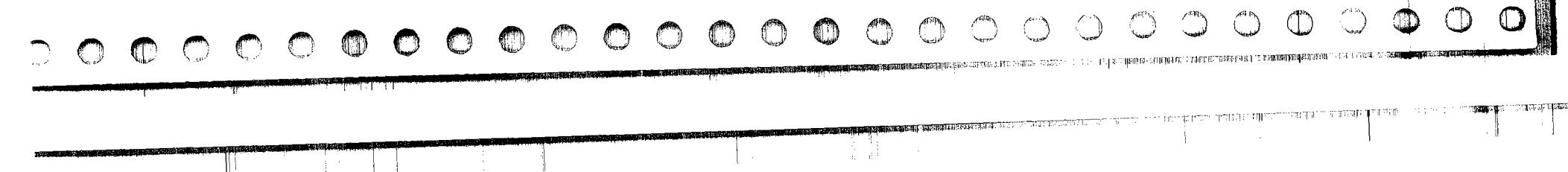
Ex:- String stno=p.getProperty("stno");

String name=p.getProperty("name");

String marks=p.getProperty("marks");

P → main memory

stno = 100
name = Sathya
marks = 97, 90



→ In the context of file programming we've two types appli.

1) They are

1. Non persistent Applications

2. Persistent Applications

→ In non-persistent appli development the result of the program stored in main memory of the computer.

→ bkt the data present in main memory is temporary.

Ex:- All our previous programs comes under non-persistent applications.

→ In persistent appli development the result of the program must be stored permanently. (Known as data persistency)

→ We can achieve the data persistency in two ways. They are

1. By using files

2. By using DB S/w

→ If we store the data permanently in the form of files then any unauthorized user can modify the data of the file becoz file concept of any language is unable to provide security in the form of user name & password.

→ If we store the data in the form of DB S/w's then we can't have any unauthorized modifications becoz most of the DB S/w products provides security in the form of user name & password.

→ As a part of JSE we are achieving the data persistency in the form of files by importing a pre-defined package called Java.io.*.

Defⁿ of file :- (Flat file)

A Collection of record is called file / Flat file

Ex :-

Student. data

1	Sathya	99.99	JNTU	← Record 1
2	Ram	86.80	OS	← Record 2
3	Ravi	70.86	JNTU	← Records

Files always resides in secondary memory. If we want to store anything in secondary memory then it should be stored in the form of file name.

Programmatically, in Java every object data will become record in the file & record of a file of secondary memory will become an object in main memory.

Defⁿ of Record :-

Collection of interrelated field values.

Ex :-

(10, Sathya, 99.99, JNTU)

→ Every value of record is called data member in the class/object

Defⁿ of Stream :-

The flow of data btw main memory & second memory is known as Stream.

Types of Streams :-

WRT the flow of data btw main memory & secondary memory is called stream. Based on the flow of data btw main memory & secondary memory we've two types of streams They are

1. Byte Streams 2. Character Streams

→ Operations on files:-

On files we can perform 2 types of operations they are

1. Write / Output Stream
2. Read / Input Stream

Write operation:-

→ The purpose of write operation is transferring temporary data from main memory into file or secondary memory.

→ To perform write operation we must use the following steps.

- a. Choose the file name
- b. Open the filename in write mode
- c. Perform cycle of write operations

→ While we are performing write operations we get the following consequences.

(a) We are attempting to transfer the temporary data of main memory into the file of secondary memory where there is not sufficient memory space.

(b) Trying to write the temporary data into the Read only file.

Due to these 2 consequences we get a pre-defined exception called java.io.IOException.

Read operation:-

Read operation is used for transferring data of file of secondary memory into the object of main memory.

→ To perform read operation we follow the following steps. (3B)

1. a. choose the filename
1. b. Open the filename in read mode
1. c. Perform the cycle of read operations

→ While we are performing read operation we get the following consequences

- a. We are attempting to open a file & it is not existing in secondary memory. Due to this we get `Java.io.FileNotFoundException`.
- b. Trying to read the data from corrupted file. Due to this we get a pre-defined exception called `Java.io.IOException`.

Byte Streams :-

→ Byte streams transfer byte by byte data b/w main memory and secondary memory.

→ Byte streams contain two categories of classes. They are

- a. Some of the category of classes participates in write operation & they will transfer one byte at a time from main memory to file of secondary memory.

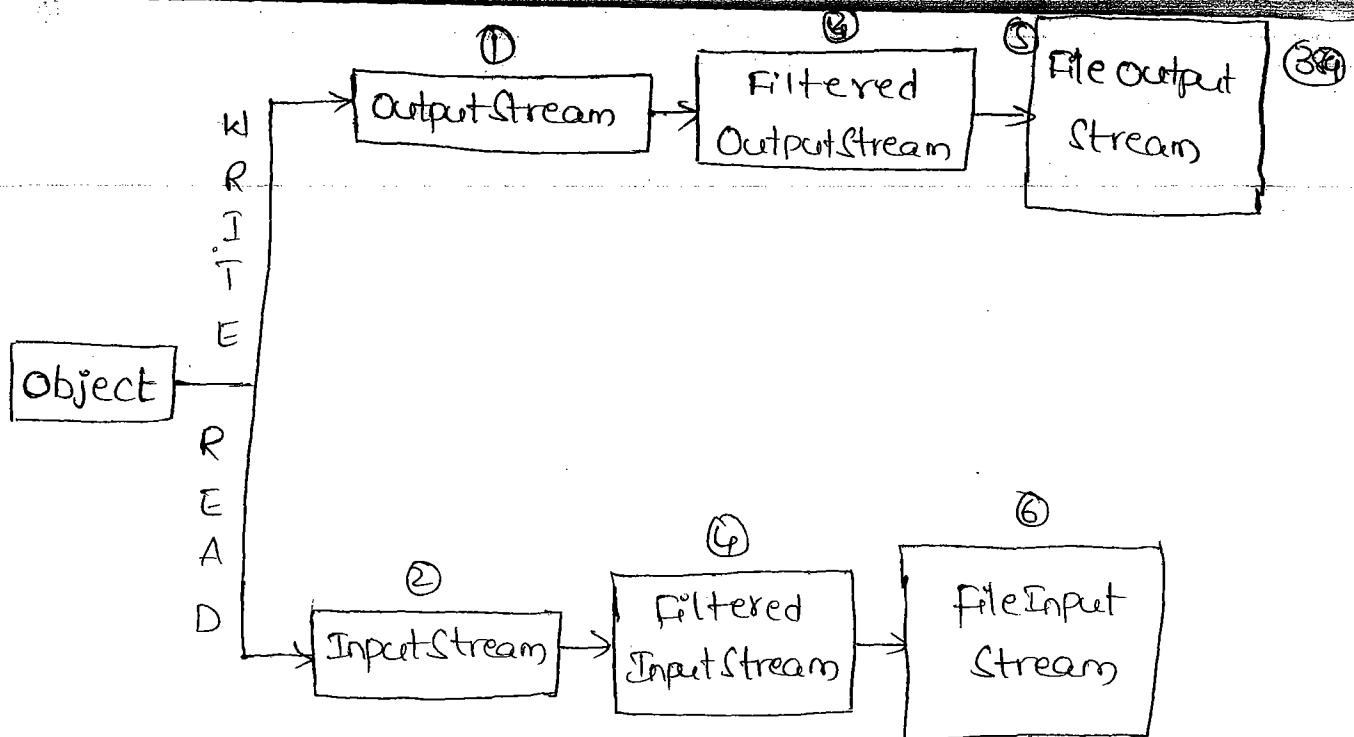
- b. Some of the category of classes participated in read operation & it can transfer one byte at a time from file of secondary memory into main memory.

→ These two category of classes present in `Java.io.*`.

Byte streams hierarchy chart :-

Hierarchy chart always makes us to understand how the features are inherited from top most base class to intermediate base classes & IBC to bottom most derived classes.

`java.io` package. don't gives list of classes present in



In the above hierarchy chart the classes ① ② ③ ⑤ are called pre defined abstract classes in Byte Stream. Since, they are abstract we can't create their object directly.

The classes ④ & ⑥ are the bottom most concrete classes in Byte Stream. Since, these are concrete we can create their objects directly & we use in our application development.

FileOutputStream :-

The purpose of FileOutputStream class is to open the file in write mode. In otherwords, opening the file name in write mode is nothing but creating an object of FileOutputStream class.

Profile of Java.io.FileOutputStream:-

Constructors:-

1. FileOutputStream(String)
2. FileOutputStream(String, boolean)

Instance methods:-

3. Public void writeXXX(xxx);
4. Public void writeLine(String);
5. public void write(xxx);
6. Public void close();

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230

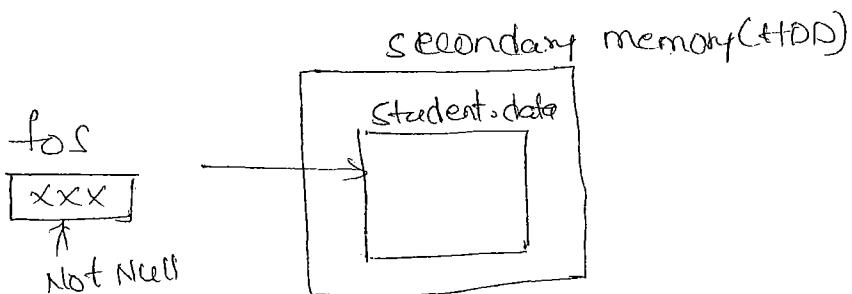
Constructors ① & ② are used for opening either the new file in write mode or existing file in write mode with appending approach (boolean = true) (or) opening the existing file in write mode with overlapping approach (boolean = false)

Ex1 :- Open a new file Student.data in write mode.

```
FileOutputStream fos=new FileOutputStream("Student.data");
```

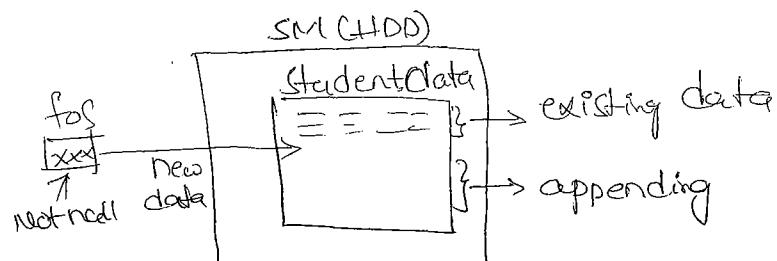
```
FileOutputStream fos=new FileOutputStream("Student.data",false);
```

```
FileOutputStream fos=new FileOutputStream("Student.data",true);
```



Ex2 :- open the existing file Student.data with appending approach.

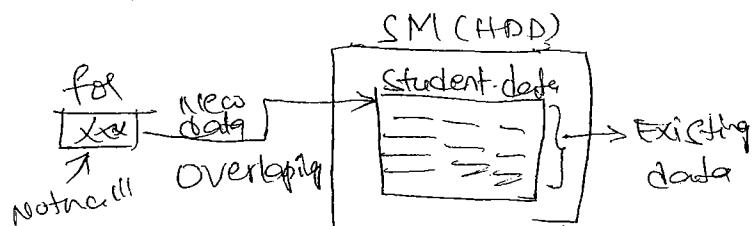
```
FileOutputStream fos=new FileOutputStream("Student.data",true);
```



Ex3 :- open the existing file Student.data with Overlapping approach.

```
FileOutputStream fos=new FileOutputStream("Student.data");
```

```
FileOutputStream fos=new FileOutputStream("Student.data",false);
```



As & When write operation is in progress for is advancing to next line

→ If there is not sufficient memory space in secondary memory to open the file in write mode (or) the file which we are opening the write mode is belongs to read only file then it theses two cases

1. foc contains null & throw IOException

→ In method:3 xxx represents any fundamental type data.

Method:3 is used for writing fundamental type data to the file.

→ Method:4 is used for writing any type of data in the form of String type.

→ In Method:5 xxx represents any fundamental type & string type data. Method:5 is one of the overloaded method & it is used for writing fundamental & string type data to the file.

→ Method:6 is used to close the file.

* The following code segment allows to close the file which was opened in write mode.

```
finally  
{  
    try  
    {  
        if(foc!=null)  
        {  
            foc.close();  
        }  
    } catch(Exception e)  
    {  
        System.out.println(e);  
    }  
}
```

FileInputStream :-

The purpose of this class is to open the file in read mode. In other words opening the file in read mode is nothing but creating an object of FileInputStream class.

Profile Java.io.FileInputStream :-

Constructor:-

1. FileInputStream (String) throws FileNotFoundException, IOException

Instance method:-

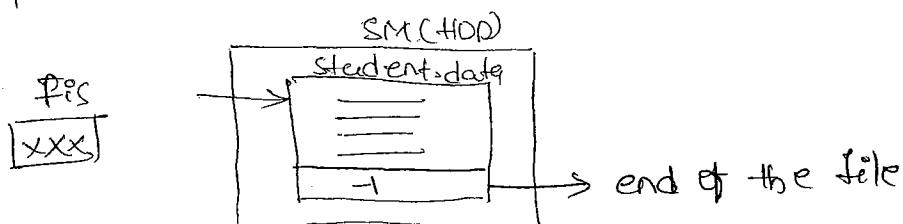
2. Public xxx readxxx();
3. Public String readLine();
4. Public int read();
5. Public void close();

Constructor: 1 is used for opening the file in read mode.

Constructor: 1 is used for opening the file in read mode.
If the specified file is not existing then we get FileNotFoundException
& if the specified file is a corrupted file then we get IOException

Ex :- Open student.data in read mode

```
FileInputStream fis = new FileInputStream("student.data");
```



When reading operation is in progress, `fis` is advancing to next lines in the file until end of file is taking place.

In Java programming end of the file is indicated by -1

If `student.data` doesn't exist & if it is a corrupted file then `fis` contains null & throws `FileNotFoundException` & `IOException`.

- 38
- In Method:2 xxx represents any fundamental type. Method:2 is used for reading fundamental type data from the file.
 - Method:3 is used for reading string data from the file
 - Method:4 is used for reading any type of data until end of file is taking place
 - Method:5 is used for closing the file which is opened in read mode.

Eg:- The following code segment makes us to close the file.

```

finally
{
    try
    {
        if (fic != null)
        {
            fic.close();
        }
    } catch (Exception e)
    {
        System.out.println(e);
    }
}

```

* Write the Java programs for performing the following.

a, write 1 to 10 numbers to the file.

b, read 1 to 10 numbers from the file.

//Filewrite.java

```

import java.util.Scanner;
import java.io.*;
class Filewrite
{
    public static void main(String [] args)
    {
        Scanner sc = new Scanner(System.in);
        System.out.println("Enter the number of lines you want to write");
        int n = sc.nextInt();
        try
        {
            FileOutputStream fos = new FileOutputStream("file.txt");
            for (int i = 1; i <= n; i++)
            {
                String s = "Line " + i + " : " + i;
                byte [] b = s.getBytes();
                fos.write(b);
            }
            fos.close();
        }
        catch (IOException e)
        {
            System.out.println(e);
        }
    }
}

```

FileOutputStream fos=null;

try

{

//Step=1

Scanner s=new Scanner(System.in);

Sop(" Enter the file name to write 1-10 nos");

String fname=s.nextLine();

//Step=2

fos=new FileOutputStream(fname,true);

//Step=3

for(int i=1;i<=10;i++)

{

fos.write(i);

} //for

Sop("data written to the file- verify");

} catch (IOException e)

{

Sop("unable to open the file in write mode");

}

catch (Exception e)

{

Sop(e);

}

//close the file

finally

{

try

{

```

        }
    }

    fof.close();
    System.out.println("file closed");
}

} catch (Exception e)
{
    System.out.println(e);
}

} // finally
}
}

```

```

} // main()
} // FileWriter-class
}

```

b) Read

// FileReader.java

```

import java.util.Scanner;
import java.io.*;
class FileReader
{
    public static void main(String [] args)
    {
        FileInputStream fis = null;
        try
        {
}

```

// Step : 1

```

Scanner s = new Scanner(System.in);
System.out.println("Enter the file name to read (10 nos)");
String fname = s.nextLine();
}

```

// Step : 2

```

fis = new FileInputStream(fname);
}

```

||Step 3

(31)

int i;

while((i=fis.read()) != -1)

{

SOP(i);

}

} catch(FileNotFoundException fe)

{

sep("file does not exists");

}

Catch(IOException ioe)

{

sep("unable to read from corrupted file");

}

Catch(Exception e)

{

sep(e);

}

|| Close the file

finally

{

try

{

if(fis!=null)

{

fis.close();

SOP("file closed");

}

} catch(Exception e)

```
    }  
    }  
}
```

```
} // finally
```

```
} // main()
```

```
} // FileRead - class
```

239 ~~WAP~~ which will copy the content of one file into another file. (or) Implement copy cmd of DOS

// Copy.java

```
import java.io.*;
```

```
Class Copy
```

```
{
```

```
public static void main (String [] args)
```

```
{
```

```
if(args.length!=2)
```

```
{
```

```
SOPC("Invalid Syntax");
```

```
}
```

```
else
```

```
{
```

```
FileInputStream fis=null;
```

```
FileOutputStream fos=null;
```

```
try
```

```
{
```

```
String sfile=args[0];
```

```
String dfile=args[1];
```

```
fis=new FileInputStream(sfile);
```

```
fos=new FileOutputStream(dfile,true);
```

```
// copy process
```

```
int i;
```

```

do
{
    p = fis.read();
    char ch = (char) p; // type casting
    fos.write(ch);
} while (p != -1);

System.out.println("Content is copied into " + dfile);

} catch (FileNotFoundException fe)
{
    System.out.println("file does not exists");
}

} catch (IOException ioe)
{
    System.out.println("unable to read from corrupted file");
}

} catch (Exception e)
{
    System.out.println(e);
}

// close the source & destination file

finally
{
    try
    {
        if (fis != null)
        {
            fis.close();
            System.out.println("source file closed");
        }
        if (fos != null)
    }
}

```

(394)

```

        {
            fos.close();
            sop(" Destination file closed");
        }
    } catch(Exception e)
    {
        e.printStackTrace();
    }
    finally
    {
        if (e != null)
            e.printStackTrace();
    }
}

```

3 // SathyaCopy
 * WAP which will display the content of the specified file
 (Implement type and of DOS)

// SathyaType.java

```

import java.util.*;
class Sathyatpe
{
    public static void main(String []args)
    {
        if(args.length != 1)
        {
            sop("Invalid syntax");
        }
        else
        {
            FileInputStream fis=null;
            try
            {
                String sfile=args[0];
                fis=new FileInputStream(sfile);
            }

```

11 type process

(393)

```
int i;
while ((i = firs.read()) != -1)
{
    char ch = (char)i; // type casting
    System.out.print(ch);
}
} // while
} catch (FileNotFoundException fe)
{
    System.out.println("file does not exist");
}
catch (IOException ioe)
{
    System.out.println("unable to read from corrupted file");
}
catch (Exception e)
{
    System.out.println(e);
}
```

11 close the file

finally

```
{
    try
    {
        if (firs == null)
        {
            firs.close();
            System.out.println("source file closed");
        }
    }
```

```

    } catch (Exception e)
    {
        System.out.println(e);
    }
}

} // main()
} // SathyaCopyType.

```

Serialization and De-Serialization

Serialization:-

Let us assume there exists an object whose size is n-bytes. If we decided to transfer the object content into the file of secondary memory by using ordinary streams (Byte Stream/Char Stream) then they takes either n-write operations (Byte Streams) or n-character write operations (Character Streams). This is one of the time consuming process.

To eliminate these redundant write operations we use another concept called "Serialization". In other words the advantage of serialization concept is that eliminating the redundant write operations & with single write operations the entire object content stored in the file of secondary memory as a record.

Defn of Serialization:-

The process of transferring/scaling the entire content of the object into the file of secondary memory by performing single write operation is known as "Serialization".

Serialization concept participates in write operation.

De-Serialization:-

Let us assume there exists a record whose size is n -bytes described in a file of secondary memory. If we want to transfer the entire record content from the file of secondary memory with ordinary streams then they takes either n -read operations (Byte Streams) (or) $n/2$ read operations (Character Streams). This process leads to time consuming process.

To overcome/eliminate these redundant read operations we use another concept called "De-serialization". In other words the advantage of De-Serialization concept is that eliminating redundant read operations & with single read operation the entire content of record of a file will be transferred into the object of main memory.

Defn of De-serialization:-

The process of transferring the entire record of a file of secondary memory into the object of main memory by performing single read operation is known as "De-serialization". De-serialization concept always participated in read operation.

Hence, the advantage of serialization & de-serialization concept is that eliminating redundant write & read operations respectively.

No. of phases required for developing serialization and de-serialization applications:-

De-serialization applications:-

To develop serialization & de-serialization apps we must learn 3 phases. These are.

1. Development serializable sub class
2. Development of serialization process
3. Development of de-serialization process

Phase: I Development of Serializable sub class

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- If any class object want to participate in serialization
- Then the corresponding class must implements a predefined
- Called `java.io.Serializable`. It is one of the marker tagged intf.
- Def of marker interfaces

Marker interface does not contain any methods explicitly
(implicitly it contains methods & they are JVM dependable overridden methods) & provides run time behaviour to its sub class.

Ex:-
`java.io.Serializable`
`java.lang.Cloneable`
`java.rmi.Remote`
`javax.Servalent.SingleThreadModel` etc

Steps:-

Step:1 Choose an appropriate package for placing Serializable sub class
for common access & ensure the package Stmt must 1st executable Stmt

Step:2 Choose an appropriate user defined class & whose modifier
must be public

Step:3 Whatever the class is selecting Step:2 must implements
`java.io.Serializable` & Step:2 class is called Serializable sub class

Step:4 Choose set of data members in Serializable sub class

Step:5 Define set of `setXXXX()` for each & every data member of
Serializable sub class for the purpose of setting the values to Serializable
sub class object (such type of methods are called Mutators)

Step:6 Define set of `getXXXX()` for each & every data member of
Serializable sub class for the purpose of getting the data from Serializable
sub class object (such type of methods are called Inspectors)

Step 7 Whatever the Serializable Sub class we are placing in the package that class must be given as the file name with an extension .java.

Ex Develop a serializable sub class for Student.

// Student.java

```
package SP;
public class Student implements java.io.Serializable
{
    int stno;
    String name;
    float marks;
    public void setStno(int stno)
    {
        this.stno = stno;
    }
    public void setName(String name)
    {
        this.name = name;
    }
    public void setMarks(float marks)
    {
        this.marks = marks;
    }
    public int getStno()
    {
        return stno;
    }
    public String getName()
    {
        return name;
    }
    public float getMarks()
    {
        return marks;
    }
```

Compile the above program

(400)

javac -d Student.java

[SP]

↳ Student.class

Hence, an object of Serializable sub class is an object of java.lang.Object.

Phase:2 Development of Serialization process

Step:1 Create an object of Serializable sub class

Ex:- Student so = new Student();

so	
0	stno
null	name
0.0	marks

Step:2 Set the values to the Serializable sub class object

Ex:- so.setStno(10);

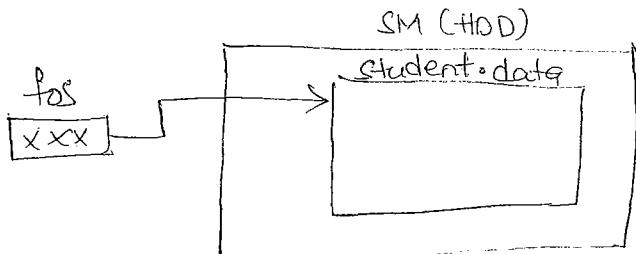
so.setName("Sathya");

so.setMarks(90.99f);

so	
10	stno
Sathya	name
90.99	marks

Step:3 Choose the file name & open it into write mode

Ex:- FileOutputStream fos = new FileOutputStream("Student.data");



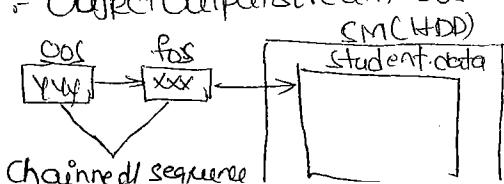
Step:4 Create an object of ObjectOutputStream (becoz fos can't write entire object data to the file)

Java.io.ObjectOutputStream

a. ObjectOutputStream(FileOutputStream)

b. public void writeObject(Object)

Ex:- ObjectOutputStream oos = new ObjectOutputStream(fos);



This step provides an environment to write serializable sub class object data to the file.

Note: If one stream object is pointing to another stream object & if both of them belongs to same category then they are called Chained/ Sequence Stream.

Step:5 Transfer/write the entire content of Serializable sub class object into file of secondary memory.

Ex:- `oos.writeObject(so);`

`SOP("Student data saved successfully in the file");`

Step:6 Close the file which was opened in write mode

Ex:- `oos.close();`

`fos.close();`

* WAP which illustrate the concept of serialization process (Save Student object data into the file)

// Serp.java

```
import SP.Student;
import java.util.Scanner;
import java.io.*;

class Serp
{
    public static void main(String []args)
    {
        try
        {
            // Step-1
            Student so=new Student();

```

// Step-2

`Student so=new Student();`

// Step-2

`Scanner s=new Scanner(System.in);`

`s.nextInt();`

(402)

```
int sno= Integer.parseInt(s.nextLine());
System.out.println("Enter student name:");
String name = s.nextLine();
System.out.println("Enter student marks:");
float marks = Float.parseFloat(s.nextLine());
so.setSno(sno);
so.setName(name);
so.setMarks(marks);
```

// Step-3

```
System.out.println("Enter the file name to write student data:");
```

```
String fname = s.nextLine();
```

```
FileOutputStream fos = new FileOutputStream(fname);
```

// Step-4

```
ObjectOutputStream oos = new ObjectOutputStream(fos);
```

// Step-5

```
oos.writeObject(so);
```

```
System.out.println("Student data saved into the file successfully");
```

// Step-6

```
oos.close();
```

```
fos.close();
```

```
} catch (IOException ioe)
```

```
{
```

```
System.out.println("unable to open the file in write mode");
```

```
}
```

```
catch (Exception e)
```

```
{
```

```
System.out.println(e);
```

```
}
```

```
} // main()
```

```
} // class
```

Phase:3 Development of Deserialization process

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Step:1 Create an object of serializable subclass for holding deserialized data.

Step:2 Choose the file name & open it into read mode.

Step:3 Create an object of ObjectInputStream (becoz FileInputStream class Object is unable to read entire record)

java.io.ObjectInputStream ↓

a. ObjectInputStream (FileInputStream)

b. public void readObject()

Ex:- ObjectInputStream ois = new ObjectInputStream (fis);

Step:4 Read the entire content of a record from file of secondary memory in to the object of main memory.

Object obj = ois.readObject();

↓

100	Sathya	75.00
-----	--------	-------

← Deserialized data

Step:5 Typecast an object of java.lang.Object into serializable subclass object.

Step:6 Obtain & display deserialized data

Step:7 Terminate/close the file which was opened in read mode

* WAJP which illustrates the concept of deserialization (read student record from the file)

II Deserp.java

```
import sp.Student;
import java.io.*;
import java.util.Scanner;
class Deserp
```

(404)

Public static void main(String [] args)

{
 //
}

1) Step-1
 Student SO = new Student();

Scanner S = new Scanner(System.in);

System.out.println("Enter the filename to read student data: ");

String file = S.nextLine();

FileInputStream f = new FileInputStream(file);

ObjectInputStream ois = new ObjectInputStream(f);

2) Step-2

Student SO = new Student();

3) Step-3

ObjectInputStream ois = new ObjectInputStream(new FileInputStream(file));

4) Step-4

Object Obj = ois.readObject();

5) Step-5

SO = (Student)Obj; // convert typecasting

6) Step-6
 Student record details;

7) Step-7
 Student NO = " + SO.getStudentNo();
 Student name = " + SO.getStudentName();
 Student MARKS = " + SO.getStudentMarks();

8) Step-8
 System.out.println("File does not exist");

 fis.close();

 ois.close();

9) Step-9

```
        catch (Exception e)
    {
        System.out.println("Exception caught");
    }
}
```

```
} //main()
} //Dserp -- class
```

Types of serializations:-

We have 2 types of serializations. They are

1. complete serialization
2. selective serialization

In complete serialization all the data members of Serializable sub class participates in serialization process.

Ex:- Student.java (See previous pages)

Here an object of ~~Serializable~~ Student class participates in complete serialization process.

In selective serialization selected data members of Serializable sub class participates in serialization.

If we don't want to make any data member of Serializable sub class to participates in serialization process then that data member declaration must be made as transient. Hence transient variables never participates in serialization process.

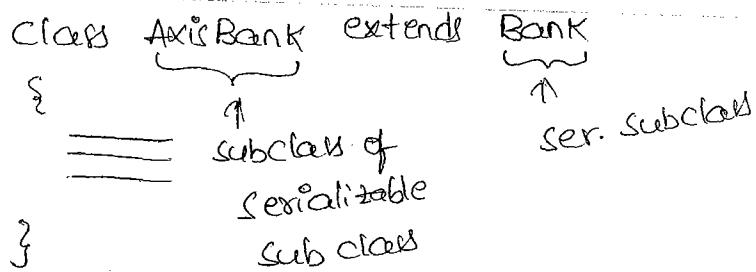
Ex:- class Bank implements java.io.Serializable

```
{  
    transient int tno;  
    String cname;  
    int acno;  
    float bal;  
}
```

Here an object of Bank class participates in Selective serialization

→ An object of subclass of Serializable subclass also participates in serialization & it is known as Automatic serialization.

Ex:-



An object of AxisBank participates in Automatic serialization.

Character Streams :-

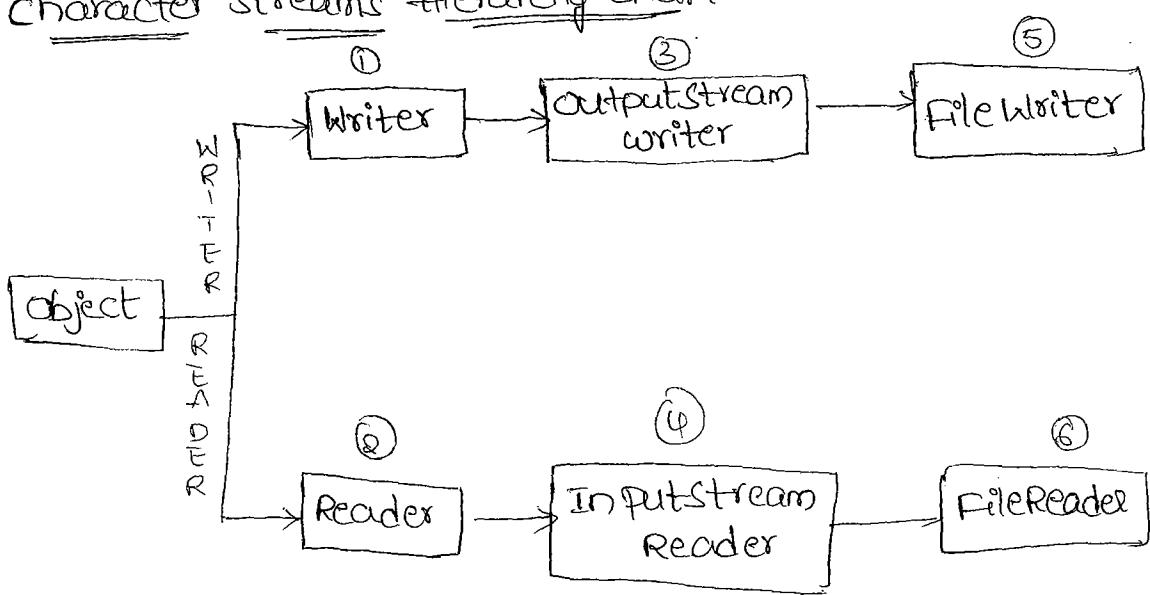
Character streams transfer 2 bytes at a time from main memory to secondary memory. Character streams are more effective than Byte streams.

→ character streams contains 2 categories of classes. They are

a) Some of the category of classes participates in write operation and they will transfer 2 bytes from main memory to file of secondary memory

b, some other category of classes participates in read operation and they will transfer 2 bytes at a time from file of secondary memory to main memory & these two categories of classes present in java.io.*;

Character Streams Hierarchy chart :-



Here 1, 2, 3 & 4 classes are pre-defined abstract classes in character streams & there is no direct usage of these classes in our apps.

The classes 5 & 6 are the bottom most concrete sub classes in character streams & we use in our app development.

- * The functionality of `FileWriter` class is more (or) less similar to `FileOutputStream` class but `FileWriter` class object writes 2 bytes & `FOS` write one byte (methods & constructors same)
- * The functionality of `FileReader` is similar to `FileInputStream` class but `FileReader` class object reads 2 bytes & `FIS` reads one byte (methods & constructors are same)

Q:- How do you clone an object.

cloning an object is nothing but duplicating the object

Ex:- `// cloneDemo1.java`

```
class Emp implements cloneable  
{  
    void disp()  
    {  
        System.out.println("emp-disp");  
    }  
  
    public Emp clone()  
    {  
        // co-varient data type  
        try  
        {  
            return ((Emp) super.clone());  
        } catch (CloneNotSupportedException e)  
        {  
            System.out.println("cloning is not possible");  
        }  
        return this;  
    }  
}
```

```

class CloneDemo1 {
    public static void main(String [] args) {
        {
            Emp oo = new Emp();
            Emp co = oo.clone();
            oo.disp();
            co.disp();
        } // main
    } // CloneDemo1

```

Defn of co-variant datatype:-

If we substitute subtype in place of supertype at the time of overriding the method then subtype of supertype is called co-variant datatype.

Ex:- The original return type of clone() is java.lang.Object under the time of overriding this clone() in the context of Emp class we can write sub-type Emp in place of java.lang.Object.

```

Ex:- // CVD.java
interface Named {
    Object getName();
}

class UrName implements Named {
    public String getName() {
        return "Sathyal";
    }
}

class CVD
{
    public static void main(String [] args)

```

↑ co-variant datatype

(40)

```
UrName u0=new UrName();
String name=u0.getName();
Sop(name);
Names n0=new Names();
String name4=(String)n0.getName(); // type casted
Sop(name4);
}
```

20/11/15

String handling

(40)

- A character is an identifier which will be enclosed within single quotes.

Valid Ex:- 'A', '\$', '9' ... etc

Invalid Ex:- 'Java', 'Sathya Tech'

String :- collection/sequence of character enclosed within double quotes is called String.

Ex:- "Java", "Sathya Tech" etc

"A", "\$", "9" etc

By default every character can be treated as String & by default String can't be treated as character.
(Programmatically, we can convert character string into character.)

Inorder to store string data & to perform various operations on string data, we've 4 types pre-defined classes.

1. Java.lang.String
2. Java.lang.StringBuffer
3. Java.lang.StringBuilder
4. Java.util.StringTokenizer

Q:- What are the differences btw String & StringBuffer.

String

1. The double quoted data is by default treated as an object of String class.

Ex:- String s = "Java"

StringBuffer

1. Double quoted data will not be treated by default as an object of StringBuffer.

Ex:- StringBuffer sb = new StringBuffer("SATHYA")
StringBuffer sb = new StringBuffer("SATHYA")

2. When we create an object of String class, we never get any additional memory space.
2. When we create an object of StringBuffer, we get 1B additional characters memory space. (41)
3. When we do any modifications on String data, the existing memory space is destroyed, new memory space is created & modified values are placed i.e., modifications are not permitted in the same space.
3. When we do the modifications on StringBuffer, they can be performed in the same space.
4. String class object is also known as immutable object.
4. StringBuffer class object is also known as mutable object.

* Similarities btw String & StringBuffer

1. These two classes are public final.
2. They never participated in inheritance (i.e. A relationship is not possible) use these classes by following Has-A & User-A relationships.
3. We can't override methods of these classes.

1. By using java.lang.String :-

We can store the String data in the main memory in two ways.

a. Directly without new operator

```
Ex:- String s1 = "JAVA";
```

```
String s2 = "JAVA";
```

```
String s3 = "Java";
```

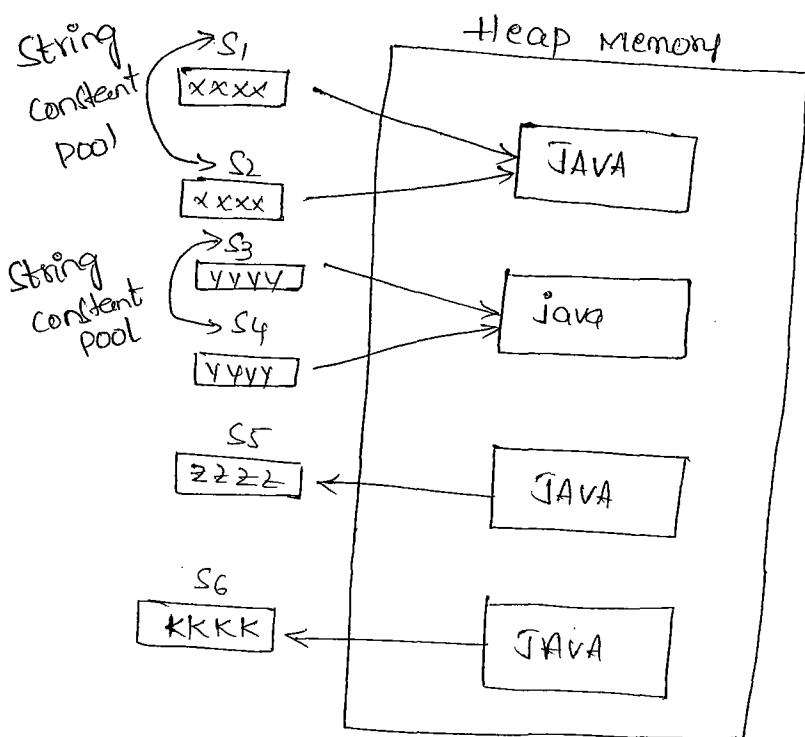
" " source

→ b. By using new operator :-

Ex:- `String s5 = new String("JAVA");`

`String s6 = new String("JAVA");`

For above two approaches the memory management diagram is shown below.



Profile of `Java.lang.String` :-

Constructors :-

1. `String()` :-

It is used to create empty String object.

Ex:- `String s = new String();`
`System.out.println(s); // empty`

2. `String(char[])` :-

It is used to convert array of characters into string.

Ex:- `char ch[] = {'J', 'A', 'V', 'A'};`

`String s = new String(ch);`

arrow → `JAVA`

JAVA

3. String (String) :-

(4B)

* This constructor is used for converting one string object into another string object (or)

* copying the content of one string object into another string object.

Ex :-

```
String s1 = "JAVA";
```

```
String s2 = new String (s1);
```

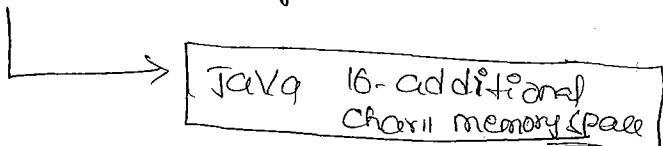
```
sop (s1); //JAVA
```

```
sop (s2); //JAVA
```

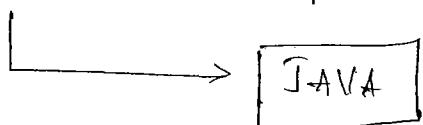
4. String(StringBuffer) :-

This constructor is used for converting StringBuffer object into String object.

Ex :- StringBuffer sb = new StringBuffer ("Java");



```
String s = new String (sb);
```



In other words, we convert mutable object into immutable object.

5. String (StringBuilder) :-

It is used to convert StringBuilder object into String class object.

41015

(H4)

Instance methods :-

1. Public int length();

This method is used for finding the no. of characters present in string.

Ex:-

```
String s = "JAVA";
s.length();
int noc = s.length();
sop(noc); //4
```

Ex:-

```
int noc = "SATHYA".length();
sop(noc); //6
```

Ex:-

```
String crs[] = {"CPP", "JAVA", "oracle"};
sop("No. of courses = "+crs.length()); //3
int noc = crs[1].length();
sop(noc); //4
```

NOTE: "length" attribute to be applied on arrays

"length()" to be applied on string objects but not to be applied on opposite.

2. Public char charAt(int);

This method is used for finding a character by passing valid position otherwise we get a pre-defined unchecked exception called Java.lang.StringIndexOutOfBoundsException.

Ex:- String s = "JAVA"; ↗ valid position
char ch = s.charAt(2);
sop(ch); //A

Char ch = s.charAt(20); ^{Invalid} position

(45)

throws StringIndexOutOfBoundsException

3. public char[] toCharArray():-

This method is used for converting string data into character array.

Ex:-

```
String s = "JAVA";
sop(s); // JAVA
Char ch[] = s.toCharArray();
for(int i=0; i < ch.length; i++)
{
    sop(ch[i]); // JAVA
}
```

ch
J
A
V
A
X

4. Public String trim():-

This method is used for eliminating leading & trailing spaces but not the spaces which are present btw the words

Ex:- String pwd = " ^{leading} JAVA ^{trailing} PROG ^{yielding}"
 | |
 T or
 spaces spaces

```
int noc = pwd.length();
```

```
sop(noc); // 15
```

```
String ts = pwd.trim();
```

```
int noc1 = ts.length();
```

```
sop(noc1); // 9
```

(416)

5. Public String toUpperCase();6. Public String toLowerCase();

The above methods are used for converting lower case data into upper case & vice versa respectively.

Ex:- String os = "Java";

String ls = os.toLowerCase();

sop(ls); //java

String us = os.toUpperCase();

sop(us); //JAVA

7. Public String substring(int);

This method is used for obtaining a part of the string by passing the position where to start & it takes upto last characters.

8. Public String substring(int s, int e=1);

This method is used for obtaining the range of the characters by specifying the positions where to start(s) & where to end(e-1). i.e. we get s to e-1 characters as a substring

Ex:- String s = "JAVA PROG";

String ss1 = s.substring(5);

sop(ss1); //PROG

String ss2 = s.substring(2, 7); // 2 to 7-1

sop(ss2); //VA PR

9. public boolean equals(String):-

This method is used for comparing two String contents.

This method returns true provided the content of source string & destination string must be same in case & meaning. Otherwise it returns false.

10. public boolean equalsIgnoreCase(String):-

This method returns true provided the contents of source string & destination string are same in meaning without considering their cases. This method returns false if the contents of source string & destination string are different in meaning.

Ex:-

```
String s1 = "JAVA";
```

```
String s2 = "java";
```

```
boolean b = s1.equals(s2);
```

```
sop(b); // false
```

```
b = s1.equalsIgnoreCase("JAVA");
```

```
sop(b); // true.
```

```
b = s1.equalsIgnoreCase("KAVA");
```

```
sop(b); // true
```

```
b = s1.equalsIgnoreCase("KAVa");
```

```
sop(b); // false.
```

- Q: What is the difference btw equals() & "==" operator (4/8)
- equals() is always used for comparison of contents of two String objects whereas "==" operator is used for comparing references of two objects

Ex:- String s1 = "JAVA";

String s2 = "JAVA";

String s3 = new String("JAVA");

String s4 = new String(s2);

If (s1 == s2)

{

executed

SOP(" s1 & s2 contains same ref "); // Valid

}

else

{

SOP(" s1 & s2 contains different ref ");

}

If (s2 == s4)

{

SOP(" s2 & s4 contains same ref ");

}

else

{

SOP(" s2 & s4 contains diff. ref "); // Invalid

}

(409)

```
if(s1.equals(s2))  
{  
    sop("Same Content"); //Valid  
}  
else  
{  
    sop("Diff: Content");  
}
```

ii. public boolean startsWith(String) :-

iii. public boolean endsWith(String) :-

The above methods are used for pattern matching.

These methods returns true provided the destination string startsWith/endsWith source string respectively. Otherwise they returns false.

Ex:- String s="JAVA is an OPP lang";

boolean b=s.startsWith("JAVA");

sop(b); // true

b=s.startsWith("Lang");

sop(b); // false

b=s.endsWith("JAVA");

sop(b); // false

b=s.endsWith("Lang");

sop(b); // true

13. Public String concat(String);

(420)

This method is used for concatenating contents of two strings but not more than two string contents. To do more than two strings content concatenation we use "+" operator

EX:-

```
String s1 = "Sathya";
```

```
String s2 = "Tech";
```

```
String s3 = s1.concat(s2);
```

```
SOP(s1); // Sathya
```

```
SOP(s2); // Tech
```

```
SOP(s3); // Sathya Tech
```

EX :-

```
String s3 = s1 + s2 + "Hyd";
```

```
SOP(s3); // Sathya Tech Hyd
```

14. Public int compareTo(String);

↑ zero

This method returns either 0(0) or +ve (-ve) value

EX:-

```
String s1 = "JAVA";
```

```
String s2 = "Java";
```

```
int cv = s1.compareTo("JAVA");
```

```
SOP(cv); // 0 → equals
```

```
c11 = s1.compareTo(s2);
```

```
SOP(cv); // +ve ⇒ destination string (s2) greater than source string (s1)
```

```
CV = s1.compareTo(ABC);
```

```
SOP(cv); // +ve ⇒ source string (s1) is greater than Dest. string (ABC)
```

Static Methods:-

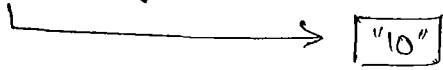
(42)

Public static String valueOf(xxx):-

In this method Xxx represents any fundamental datatype, it is one of the overloaded static factory method & it is used for converting fundamental type values into String type values.

Ex:-

```
int a = 10;  
String str = String.valueOf(a);
```



```
System.out.println(str);
```

```
float x = 1.5f;
```

```
String str = String.valueOf(x);
```



```
System.out.println(str);
```

2. Java.lang.StringBuffer:-

It is one of the pre-defined public final class & it never participates in inheritance process. When we create an object of StringBuffer we get 16 additional character memory space & whole object is known as mutable object.

To perform the operations on string data by using StringBuffer class we need learn its profile.

Profile Java.lang.StringBuffer:-

Constructors:-

1. StringBuffer(char[])
2. StringBuffer(StringBuffer)
3. StringBuffer(String) → Converting String class object into StringBuffer
4. StringBuffer(StringBuilder)

→ constructor:1 is used for converting array of characters into (42)
StringBuffer object.

EX:- `char ch[] = { 'J', 'A', 'V', 'A' };`

`StringBuffer sb = new StringBuffer(ch);`

`SOP(sb); // JAVA`

JAVA 16 additional chars
space

→ constructor:2 is used for converting one StringBuffer object
into another StringBuffer object

EX:- `StringBuffer sb = new StringBuffer("JAVA");`

`StringBuffer sb1 = new StringBuffer(sb); // OPC`

`SOP(sb); // JAVA`

`SOP(sb1); // JAVA`

→ constructor:3 is used for converting String class object
data into StringBuffer object. In other words this constructor
converts immutable object into mutable object.

EX:- `String s = "JAVA";`

JAVA

`SOP(s); // JAVA`

`StringBuffer sb = new StringBuffer(s);`

JAVA 16 additional chars

`SOP(s); // JAVA`

`SOP(sb); // JAVA`

→ constructor:4 is used for converting StringBuilder object into
StringBuffer class

NOTE:- String constant pool exists only for String class objects becoz
one can initialize the String class object without new operator whereas
String constant pool will not exist for StringBuffer class objects becoz every
object is initialized with new operator but not directly.

Instance Methods

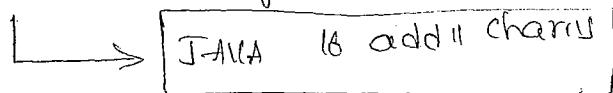
(423)

1. Public int length()
2. Public int capacity()

The above methods are used for finding no. of characters & capacity (no. of chars + 16 - additional chars) of StringBuffer object.

Ex:-

```
StringBuffer sb = new StringBuffer("JAVA");
```



```
sop(" No. of. chars = "+sb.capacity()); //4
```

```
sop(" Cap of sb = "+sb.capacity()); //20 (4+16)
```

3. Public StringBuffer reverse()

This method is used for obtaining sentence reverse of StringBuffer object.

Ex:-

```
StringBuffer sb = new StringBuffer("JAVA PROG");
```

```
StringBuffer sb1 = sb.reverse();
```

```
sop(sb); //JAVA PROG
```

```
sop(sb1); //GORP AVAJ
```

4. Public String toString()

This method is used for converting StringBuffer object (mutable) into String class object (immutable).

Ex:-

```
StringBuffer sb = new StringBuffer("JAVA");
```

```
String s = sb.toString();
```

```
sop(s); //JAVA
```

5. Public void trimToSize():-

This method is used for eliminating additional characters memory space & adjust the StringBuffer object memory upto only to its length.

Ex:-

```
StringBuffer sb=new StringBuffer("JAVA");
SOPC" cap of sb = " + sb.capacity(); //20
```

SOPC" cap of sb after trim = " + sb.capacity(); //12

sb.trimToSize();

SOPC" cap of sb after trim = " + sb.capacity(); //4

6. Public int codePointAt(char):-

This method is used for obtaining unique code value of a specific character which is present in the object of StringBuffer

Ex:-

```
StringBuffer sb=new StringBuffer("JAVA");
```

int uc = sb.codePointAt('A');

SOP(uc); // 65

7. Public void setCharAt(int, char):-

This method is used for replacing the existing character with new character by specifying the position of existing character.

Ex:- StringBuffer sb=new StringBuffer("KAWA");

SOP(sb); // KAW

sb.setCharAt(0,'J');

SOP(sb); // JAVA

8. Public StringBuffer append(Object)

9. Public StringBuffer append(String)

10. Public StringBuffer append(StringBuffer)

11. Public StringBuffer append(XXX) → Here XXX represents String and StringBuffer

The above methods are used for appending string data, (Ans)
StringBuffer data, fundamental data & any type of object data
to the content of existing StringBuffer object data.

Ex:-

```
StringBuffer sb=new StringBuffer("JAVA");
```

```
StringBuffer sb1= sb.append(" PROG");
```

```
SOP(sb1); // JAVA PROG
```

```
StringBuffer sb2= sb1.append(10);
```

```
SOP(sb2); // JAVA PROG 10
```

12. public StringBuffer delete(int, int):-

This method is used for removing range of characters by specifying the position where to start & where to end.

Ex:- StringBuffer sb2=new StringBuffer("JAVA PROG");

```
SOP(cb); // JAVA PROG
```

```
StringBuffer sb1= sb.delete(4,7)
```

```
SOP(sb1); // JAVA
```

13. public StringBuffer deleteCharAt(int):-

```
SOP(cb2); // JAV
```

13. public StringBuffer deleteCharAt(int):-

This method is used for deleting a particular character by specifying its position

14. public StringBuffer replace(int,int, String):-

This method is used for replacing range of characters with the specified new string.

EX:-

StringBuffer sb = new StringBuffer("JAVA PROG");
sb.append(" "); // JAVA PROG

(426)

StringBuffer sb1 = sb.replace(4, 7, "LANG");
sb.append(" "); // JAVA LANG

15. public StringBuffer insert(int, String) :-

This method is used for inserting a new string in the existing data of StringBuffer by specifying the existing position.

Ex:-

StringBuffer sb = new StringBuffer("JAVA LANG");
sb.append(" "); // JAVA LANG
StringBuffer sb2 = sb.insert(4, "PROG");
sb2.append(" "); // JAVA PROG LANG

3. Java.lang.StringBuilder :-

The functionality of StringBuilder is exactly similar to StringBuffer but StringBuilder methods are non-synchronized gives non thread safety results & recommended to use in server side apps whereas StringBuffer class object & whole methods are synchronized & gives thread safety results & recommended to use in client side apps. [Constructors of StringBuilder are similar to constructors of StringBuffer, methods of StringBuilder are similar to StringBuffer methods without synchronized.]

4. Java.util.StringTokenizers

- It is one of the predefined class present in Java.util.*
- The purpose of StringTokenizer is split the given string into different Substring based on delimiter

→ Some of the delimiters are . , ; :

→ StringTokenizer always separates the given string by considering delimiter. Delimiter separated values are called Tokens

Profile of Java.util.StringTokenizer

Constructors:-

1. StringTokenizer(string)
2. StringTokenizer(string, String)

Instance Method:-

3. Public int countTokens()
4. Public boolean hasMoreTokens()
5. Public string nextToken()

constructor:1 is used for creating an object of StringTokenizer without specifying delimiter.

Constructor:2 is used for creating StringTokenizer by specifying delimiter.

Method:3 is used for counting the no. of tokens which are separated by delimiter.

Method:4 returns true provided an object of StringTokenizer having more no. of tokens otherwise it returns false

Method:5 is used for obtaining next token w.r.t the object of StringTokenizer provided method:4 returns true.

* Write a Java program which illustrates the concept of StringTokenizer.

1) StrTok.java

```
import java.util.StringTokenizer;
class StrTok
```

```
public static void main(String[] args)
```

{

```
StringTokenizer st=new StringTokenizer("Java is QD
```

oop lang", "#"); //Here '#' is called delimiter

```
int n=st.countTokens();
```

```
sop("no.of.Tokens=" + n);
```

```
while(st.hasMoreTokens())
```

{

```
String tok=st.nextToken();
```

```
sop(tok);
```

}

}

}

Inner/nested classes:-

Def: If we define a class Y inside the definition of another class X then the class Y is called inner class & the class X is called outer class.

The process of defining one class definition into another class definition is known as containership.

We have 4 types of inner classes

1. static inner class
2. member inner class
3. local inner class
4. anonymous inner class

Static inner class:-

→ The purpose of static inner class is performing one type common operations by taking static features.

→ Just static classes are not there in Java but one can write inner static classes.

→ We can't refer outer class instance properties (data member of method) from the context of inner static class.

→ programmatically, in the static inner class we can take both static & instance features (recommended to take static features).

Syntax for static inner class:-

class<outer class>

{

 =====

 static class<inner class>

{

 =====

 } // inner class

} // outer class

* KJJP which illustrate the concept of static inner classes.

// XY.java

class X

{

 int a=10;

 static int b=20;

 void xyz();

{

 System.out.println("Val of a of x = "+a);

 System.out.println("Val of b of x = "+b);

 System.out.println("Val of c of y = "+new Y().c);

 System.out.println("Val of d of y = "+y.d);

}

Static class Y

{

 int c=30;

 static int d=40;

```
void abc()
```

{

// Sop("val of a from x = " + a); Invalid

Sop("val of b from x = " + b);

Sop("val of c from y = " + c);

Sop("val of d from y = " + d);

}

} // Y - inner class

} // X - outer class

Class XY

{

public static void main(String[] args)

{

X o1 = new X(); // creating an object of outer class

o1.xyz();

X.Y o2 = new X.Y(); // creating an object of static inner class

o2.abcd();

}

}

Instance inner class:-

→ Instance inner classes contains only instance features & it never contains static features.

→ The purpose of instance inner class is performing some repeated operation by containing instance features.

→ Instance inner class can access all the features of outer class & outer class also access instance inner class feature

* WAP which illustrate concept of instance inner class. (43)

1) PQ.java

```
class P
{
    int a = 10;
    static int b = 20;
    void abc()
    {
        System.out.println("val of a of P = " + a);
        System.out.println("val of b of P = " + b);
        System.out.println("val of c of Q = " + new Q().c);
    }
}
```

class Q { instance class }

```
{}
int c = 30;
// static int d = 20; invalid
// static void pqr() {} - invalid
void xyz()
{
    System.out.println("val of a of P = " + a);
    System.out.println("val of b of P = " + b);
    System.out.println("val of c of Q = " + c);
}
```

} //xyz

} //Q

} //P

class PQ

```
{}
public static void main(String[] args)
```

P o1 = new P();

o1.abc();

P.Q o2 = new P().new Q(); // creating an object of instance inner class

o2.xyz();

}

local inner class :-

→ If we define a class definition inside the method of another class then class definition present inside the method definition is called local inner class.

→ Local inner class must be instance class but it should not belongs to public, protected, private & static.

→ Local inner class method can be accessed within the containing method only but not in other method of outer class.

* WAP which illustrate local inner class.

// LIC.java

class Sathye,

{

void learnJava()

{

Sop("Learning Java from Sathye");

class Faculty,

{

void teachJava()

{

Sop("Learning from xyz faculty");

}

} // Faculty - local inner class

Faculty f = new Faculty();

(433)

f.teachJava();

} // learnJava()

} // Sarthya - outer class

class UC

{ public static void main(String[] args)

{ Sarthya s = new Sarthya();

s.learnJava();

}

}

Anonymous inner class:-

→ An Anonymous inner class doesn't contain any explicit name given by the programmer

→ The purpose of Anonymous inner classes is to implement abstract method of abstract classes & interfaces.

→ For more explanation, for more example see inner interfaces in previous pages (Interface topics).