JAVA FULL STACK DEVELOPMENT

DETAILED HANDWRITTEN NOTES

PART I – CORE JAVA I

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TOPICS COVERED:

- Programming Fundamentals
- Object Oriented Principles
- Exception Handling

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JAVA

First code in Java:

```
Class FirstCode
{
    Public Static Void main (String a[])
    {
        System.out.print ("Hello World");
    }
}
```

(for visibility; to recieve command line arguments)

Two things to do to run java program.

1. javac <file name>
2. java c <Class name>

* When you compile the code internally it will create a file which is ".class" file.
* When you make the class as public then you need to name the classname same as file name.
* In one file you can create multiple classes, and when
* you compille it multiple ".class" files are created i.e for every class a .class file is created.

.jar - Java Archive : It's a file format based on the popular ZIP file format and is used for aggregating many files into one.

Main Method in Java :

In Java the main() method is the Starting point from where compiler starts program execution.

Four things the method will have: 1. name
2. parameter
3. body
4. return type.

Difference between war file and .class file?

- .class file: Source code that is converted by a compiler that is a .class file
- .war file: Collection of many .class files + .html files which is compressed we call as .war file
- .jar file: Collection of many .class files which is compressed we call as .jar file.

OOPS (Basic Introduction)

* It stands for Object Orientation Principles
* Object: realtime instance like Car, Student, Employee etc.
* Every Object in realtime will have two parts:
  (a) what it does
  (b) what it has

Java code:

```
Class Car
{
    // HAS part of an Object is represented as a "variable".
    String brandName;
    int noOfWheels;

    // DOES - part of an object is represented through "methods"
    Public void move()
    {   // logic of moving a vehicle
        }

    Public void acclerate()
    {   // logic of acclerations
            }.
}
```

Identifier: * it is a name in java program
* it can be a class name, method name, variable name and label name.

Ex 1.
```
Class Test
{
    public static void main (String [] args)
    { int x = 10; }
}
```
Total 5 identifiers.

Ex 2.
```
Class Test
{
    public static void main (String [] args)
    { System.out.println ("Sachin"); }
}
```
Total there are 7 identifiers

Ex 3
```
Class Demo
{
    public static void main (String [] args)
    { String name = "Sachin";
      String result = name.toUpperCase();
      System.out.println (result); }
}
```

Rules for writing an identifier:

1. The only allowed characters in java identifiers are:
a to z, A to Z, 0 to 9, _ (underscore), $

2. If we use any other characters it would result in error.

3. Identifiers are not allowed to start with digits.
int telusko1 = 100; (valid)
int 1telusko = 100; (invalid)

4. Java identifiers are case sensitive (number != Number)

5. There is no length limit on java identifiers, but still it is a good practise to keep the length not more than 15 characters.

6. We can't use reserve words as a identifiers
eg: int if = 10; (compiler error)
* String — inbuilt classname
* Runnable — inbuilt interface name.
* Student — user defined classname

7. Predefined class names can be used as identifiers
eg: * String Runnable = "sachin";
System.out.println(Runnable); // Sachin.

* int String = 10;
System.out.println(String); // 10

Even though predefined class names can be used as an identifiers, it is not a good practice to keep.

* int If = 10; if != IF.
System.out.print(If); valid✓

* int int = 10;
System.out.print(int); CE.

Note:
Literal: Any constant value which can be assigned to a variable is called literal.
int data = 10; literal → 10
data → variable name, int → datatype

Note: For boolean datatypes the only values allowed for variable is "true" and "false", other than this if we try to keep the values (any) it would result in "Compile Time Error".

Q1. Which of the following list contains only reserve word?

1. final, finally, finalize

Ans: finalize is not a reserve word, it is a method in Object class.

2. break, continue, exit, return

Ans: exit is not a reserve word, it is a method in System class.

3. byte, Short, Integer, long

Ans: Integer is not a reserved word, it is a predefined class.

4. throw, throws, thrown

Ans: thrown is not a reserved word, it is a user-defined variable.

Datatypes:

Every variable has a type, every expression has a type and all types are Strictly typed / defined in java, because java is Strictly type / Statically typed language.

Compiler role → compiler will check the value stored can be handled by datatype or not. This checking which is done by compiler is called "Type checking / Strictly type checking"

Primitive Datatypes: data which is commonly used and supported by any language to store directly.

(a) Numeric values: to store number
- whole number, real number

(b) Character values: to store character type of data

(c) Boolean values: to store logical values.

Number data:

To store whole numbers we have 4 data types

(a) byte (c) int

(b) short (d) long

Data type information like:

(a) Size of datatype (how much memory is allocated on the ram for that datatype by JVM)

(b) min value what it can keep

(c) max value it can keep.

Note:

* System.out.println("Size of byte is ::"+Byte.SIZE);
* System.out.println("minvalue of byte is ::"+Byte.MIN-VALUE);
* System.out.println("maxvalue of byte ::"+Byte.MAX-VALUE);

a. byte:

Output: Size → 8 bits

min value → −128

max value → 127

eg:

byte marks = 35 // valid

byte marks = 135 // CE: possible loss of precision

byte a = "a"; // CE: incompatible types.

Q2 When to use byte datatype?

It is commonly used when we handle the data which is coming from Stream, network.

Stream → java.io package

* " " → means String
* ' ' → char data

b. Short :

Size : 16 bits (2 byte)
min value : - 32768
max value : + 32768

Note : this data is not at all used in java and this data type is best suited only if you have old processors.

c. int :

Size : 32 bits (4 byte)
min value : - 2147483648
max value : + 2147483647.

Note : the most commonly used datatype for storing whole number is "int" and by default if we specify any literal of number, compiler will keep it as "int".

d. long :

Size : 64 bits (8 bytes)
min value : -2^{64-1}
max value : $+2^{64-1}$

Note : when we work with large files, data would come to java program in terms of GB's, int is not enough so we use long.

★ If the data goes beyond the range of int, then keep the data inside the long data type we need to explicitly suffix the data with 'L' or 'l' otherwise it would result in "Compile Time Error".

Real Number

(a) float

Size : 32 bits (4 byte)
min value : 1.4E - 45
max value : 3.4028235E38

Note : by default if you specify any real number / dec number compiler will treat it as "double", to specify to treat as float, we need to suffix with "F" or "f"

eg: float a = 10.5 - C.E
float b = 10.5f; } valid
float C = 25.5F; }

(b) double

Size: 64 bits (8 bytes) eg: double d = 23.567;

min value: 4.9E-324 double d = 1.797...57E308;

max value: 1.79...E308

Note: Datatypes are actually represented to the compiler and jvm using reserve words. reserve words normally in "lower case".

To map primitive data as Object in java from JDK 1.5 concept of "Wrapper Class" was introduced

1. byte → Byte
2. Short → Short
3. int → Integer
4. long → Long
5. double → Double
6. float → Float

Char Data types:

Size: 16 bit (2 Byte)

Java was developed for multilingual languages it adopted the Unicode System i.e there are 65,535 characters where as in 'C' Char has just 8 bit (1 byte) and it adopted ASCII system (0 to 128)

eg:

Char a = 'A'; valid

Char a = "A"; invalid - *Single quote only

Char a = "AB"; invalid - no two Chars allowed, *only one!

*Char → Character (class)

Type casting: Changing one type of data to another type.

→ (implicitaly) → without any efforts or automatically is called "implicit type casting".

↓ also called "Numeric type promotion"

eg: int a = 25;

int b = 2;

float c = a/b; o/p = 12.0 (int → float converted)

* Implicit Typecasting happens in
byte → short → int → long → float → double
left to right is possible but reverse is not possible implicitly.

Explicit typecasting : Changing type of data to another type with extra efforts is called "explicit typecasting".

eg: 1. double a=45.5;
byte b;
b = (byte) a;
System.out.println(b); Output: 45 (Data loss may occur)

2. byte ab=10;
byte ac=20;
byte res = ab*ac;
* (result in error because resultant will be an integer by default.

Solution:
* (byte) ab*ac;
or * int res = ab*ac;

Incrementation	Decrementation

* Pre increment = ++a;
* Post increment → a++;
 	
eg: int a=5; int b;
b=a++;
System.out.print(a); - 6
System.out.print(b); - 5
 	
if: b = ++a;
System.out.print(b); - 6
	* Pre increment → --a;
	Post increment → a--;
	
	* In pre increment or pre decrement the value of variable is first changed then assigned to a variable if assignment operator is there.

Example: int a = 5;
int b;
b = a++ + a++ + ++a; → 5 + 6 + 8
System.out.print(a); → 8
System.out.print(b); → 19

Code Snippets :

1. For the code below what should be the name of java file?

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

Ans: HelloWorld.java (Identifiers are case sensitive)

2.
```
public class MyFile
{  public static void main (String [] args)
   {  String arg1 = args [1];
      String arg2 = args [2];
      String arg3 = args [3];
      System.out.println ("Arg is " + arg3); }
}
```

Which command line arguments should you pass to program to obtain the following output: Arg is 2

Ans: java MyFile 1 3 2 2. (arg[3], so 4th ind = 2)

3.
```
public class Test
{  public static void main (String [] args)
   {  System.out.print ("Hello");;;; }
}
```

Does the code compile sucessfully?

Ans: Yes

multiple semicolons won't do anything.

4. What is the signature of special main method?

Ans: public static void main (String [] a)

5. What will be result of compiling and executing Test class?

java Test good morning everyone

```
Private class Test
{   public static void main (String [] args)
    { System.out.println(args[1]); }
}
```

Ans: Compilation error (because of private class)

6. For the class Test, which options, if used to replace /*INSERT*/, will print "Hurrah I passed...." on to the console?

```
Public class Test
{   /*INSERT*/
    { System.out.println ("Hurrah I passed..."); }
}
```

Ans: public static void main (String [] args)

static public void main (String [] a)

7. Suppose you have created a java file, "myClass.java". Which of the following commands will compile java file?

Ans: javac myClass.java

'for compilation and java for execution

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Operators in Java

1. Arithematic Operators (+, -, *, /, %)
2. Increment and decremental operators (++ and --)
3. Logical operators (&&, ||, !)
4. Assignment operators (=)
5. Conditional operators (if, else, ternary Operator)
6. Relational operators (==, !=, >, <, >=, <=)
7. Bitwise and shift operators

* Unary Operator: Unary operators require only one operand. operations such as: incrementing/decrementing, negating an expression or inverting a boolean.

* binary operators: Operators which require atleast two operands to perform operations are called binary op.

* ternary operator: Operator which require 3 operands and it is the only conditional operator that takes three operands.

eg: int a=5, b=10;
int res = (a>b)? a:b; (Syntax (exp1)? a:b)
System.out.print(res); → 10

Switch Statement: The switch statement executes one statement from multiple conditions like if-else if ladder statement.

Syntax: Switch (expression){
Case value 1: Code to be executed; break;
Case value 2: Code to be executed; break;
default: Code to be executed if no case matching }

* break - optional.

Code Snippets:

1. * File name: Test.java

```
public class Test{
  public static void main(String[]args)
  { args[1] = "Day!";
    System.out.print(args[0] +" "+ args[1]); }
}.
```

→ And the commands: javac Test.java
java Test Good

Result?

Ans: Jvm would create a problem during execution as args[1] there was no memory, memory was till args[0] because of one argument "Good" so exception!

2. File name: Test.java

```
public class Test{
  public static void main (String [] args)
  { System.out.println ("Welcome" + args[0] + "!"); }
}
```

→ And the commands are: javac Test.java
java Test "James Gosling" "Bill Joy"
args[0]

What is the result?

Ans: Welcome James Gosling! (we use " " to ignore the spaces).

3.

```
public class Test{
  public static void main (String [] args)
{ boolean b1 = 0;
  boolean b2 = 1;
  System.out.print(b1+b2); }
}
```

Ans: Compilation Error.

4. Given:

```
35. String #name = "Jane Doe";
36. int $age = 24;
37. Double _height = 123.5;
38. double ~temp = 37.5;
```

Which two statements are true?

Ans: Line 35 and 38 will not compile.

5.
```
public class Test{
 publicstaticvoid main(String[]args) : public static void main
  { byte b1 = (byte) 127+21;                  it's correct.
    System.out.print(b1); }
}
```

148 can't be stored in byte

So: Jvm will do min range + (rec-max-1)
= -128 + (148 - 127 - 1)
= -108 (formula for every datatype)

Ans: -108

6.
```
Public Class Test{
 public Static void main (String [7args)
{ Char c1 = 'a'; // ASCII value of 'a' is 97
   int i1 = c1;
   System.out.print(i1); }
}
```

Char → int (implicit typecasting)

Ans: 97

7.
```
Public Class Test{
  public static void main (String [7args)
{ byte b1 = 10;
   int i1 = b1;
   byte b2 = i1;
  System.out.print (b1 + i1 + b2); }
}
```

byte → int (implicit)

int → byte (not possible, need to tell explicitly)

Ans: line 3 causes compilation error.

8. What will be the output?

```
int x = 100;
int a = x++;   → a=100, x=101
int b = ++x;   → b=102, x=102
int c = x++;   → c=102, x=103.
int d = (a<b)? (a<c)? a : (b<c)? b : c : x;
            (100<102) ? (100<102) : 100
System.out.print(d);
```

Ans: The output will be 100.

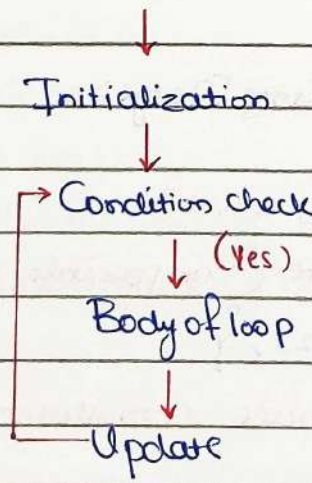
9.
```
Class Test{
public static void main (String [] args)
 { int a = 100;
   System.out.print (-a++); }
}
```

Ans : -100.

Loops in Java: Looping in programming language is a feature which facilitates the execution of set of instructions repeatedly while some condition is true.

Types of loops are: ① for()
② while()
③ do-while()
④ for-each (enhanced for loop)

1. for



→ for (init; cond^{n}; update)
{ Body }.

eg: for (int i=0; i<n; i++)
{ System.out.Print("*"); }

2. While (boolean condition)
{ loop statements... }

While loop starts with checking boolean condition. If true executed otherwise not. It is also called as "Entry control loop".

3. do while

```
do {
    Statements }
while (condition);
```

do while loop is similar to while loop with only difference that is it checks for condition after executing statements, and therefore also called as "Exit control loop".

Ex 1.

```
int n=4
for (int i=0; i<n; i++)
{   for (int j=0; j<n-1; j++)
    {
      if (i==0 || i==3 || j==0 || j==3)
        System.out.print("*");
      else
        System.out.print(" "); }

    System.out.println();
}
```

Output:

```
   j=0 1 2 3
i=0 * * * *
1   *     *
2   *     *
3 * * * *
```

Ex 2.

```
int n=10;
for (int i=0; i<n; i++)
{   for (int j=0; j<n; j++)
    {
      if ((i==0 && j<n-1) || j==0 || (i==n-1 && j<n-1) ||
          (j==n-1 && i>0 && i<n-1))
        System.out.print("*");
      else System.out.print(" "); }
}
```

O/P: "D"

```
* * * *
*     *
*     *
*     *
* * * *
```

Code Snippets :

1.
```
Public Class Test
{ public Static void main (String [] args)
  { char c = 'z';
    long l = 100-001;
    int i = 9-2;
    float f = 2.02f;
    double d = 10-0.35d;
  }
```

`l = c + i;` → char + int = int → long

`f = c * l * i * f;` → Float (higher datatype)

`f = l + i + c;` → long → float

`i = (int) d;` → long → float (implicit)

`f = (long) d; }`

Does code compile sucessfully?

Ans: YES.

Note: from Jdk 1.7 for a literal we can give '_' also, if we give compiler will remove that '_' in .class file.

2.
```
{ int a = 20;
  int var = --a * a++ + a-- - a--a;
  System.out.print ("a = " + a);
  System.out.print ("var = " + var); }
```

Result : a = 18 var = 363

3.
```
{ int i=5;
  if (i++<6){        5<6
    System.out.println (i++); }
                          (6 then ++
}
```

Output : 6

4. `int x=4; int y=4++;` ← post increment done only on variables not literals. Ans: Compilation error.

```
System.out.println (x);
System.out.println (y);
```

5 int x = 4;
int y = ++(++x); → Line 2 : Compile Time Error
System.out.print(x); (Because incrementation done only on
System.out.print(y); variables not on direct literals).

6 boolean b = true;
b++; Ans: Line 2 : Compile time error
System.out.println(b); because increment/decrement not
applicable on boolean type.

7. int b, c, d;
int a = b = c = d = 10; Ans: Yes, the code will compile.
Will the code compile?

8. int a = b = c = d = 20; Ans: No, because b, c, d not initialized.
System.out.println(a);

9. byte c = (10 > 20) ? 30 : 40; int
byte d = (10 < 20) ? 30 : 40; Ans: 40
System.out.println(c); 30
System.out.println(d);

10. int a = 10; int b = 20; — type checking is valid
byte c = (a > b) ? 30 : 40; - literals are not involved in operations,
byte d = (a < b) ? 30 : 40; So compiler would just check typechecking of result.

Ans: Compile Time Error.

11. int x = 5---0; How many Statements are legal?
int y = ___50; ✗ '_' should not be in beginning/end, okay in b/w.
int z = 50---; ✗ Ans: three Statements only
float f = 123.76_86f;
double d = 1_2_3_4;

12.
```
int x = 10;
if (++x < 10 && ((x/0)>10){
    System.out.println("Hello"); }
else
    System.out.println("Hi");
```
Ans: "Hi" is printed.

13.
```
int i =10;
int j= 20;
int k = (j+=i)/5;
System.out.println(i+":"+j+":"k);
```
Ans: 10:30:6

14.
```
int x=10;
if (x) System.out.println("hello");
else System.out.println("hiee");
```
if (boolean exp.) = Syntax
↓
in this code int is found so error.

Ans: Compile Time Error.

15.
```
int x=10;
if (x=20) System.out.println("hello");
else System.out.println("hiee");
```
Ans: Compile time error because of assignment operator.

16.
```
boolean b = false;
if (b=true) System.out.println("hello");
else System.out.println("hiee");
```
Ans: "hello" because assignment operator is evaluated on boolean type.

17.
```
if (true)
    System.out.println("hello");
```
Ans: "hello" is printed

18. Public class Test{
    public static void main(String [] args){
    if (true); }
}

Ans: No output. (";" is a valid java statement)

19. Public class Test{
    public static void main (String [] args){
    if (true)
    int x=10; }
}

Ans: Compile time error.

Note: if there is only one statement which needs to be a part of "if" then { } is optional, but statement should not be a declarative statement.

20. if (true)
System.out.println("hello");
System.out.println("biee");

How many statements are independent of if?

Ans: 1 statement.

OOPs.

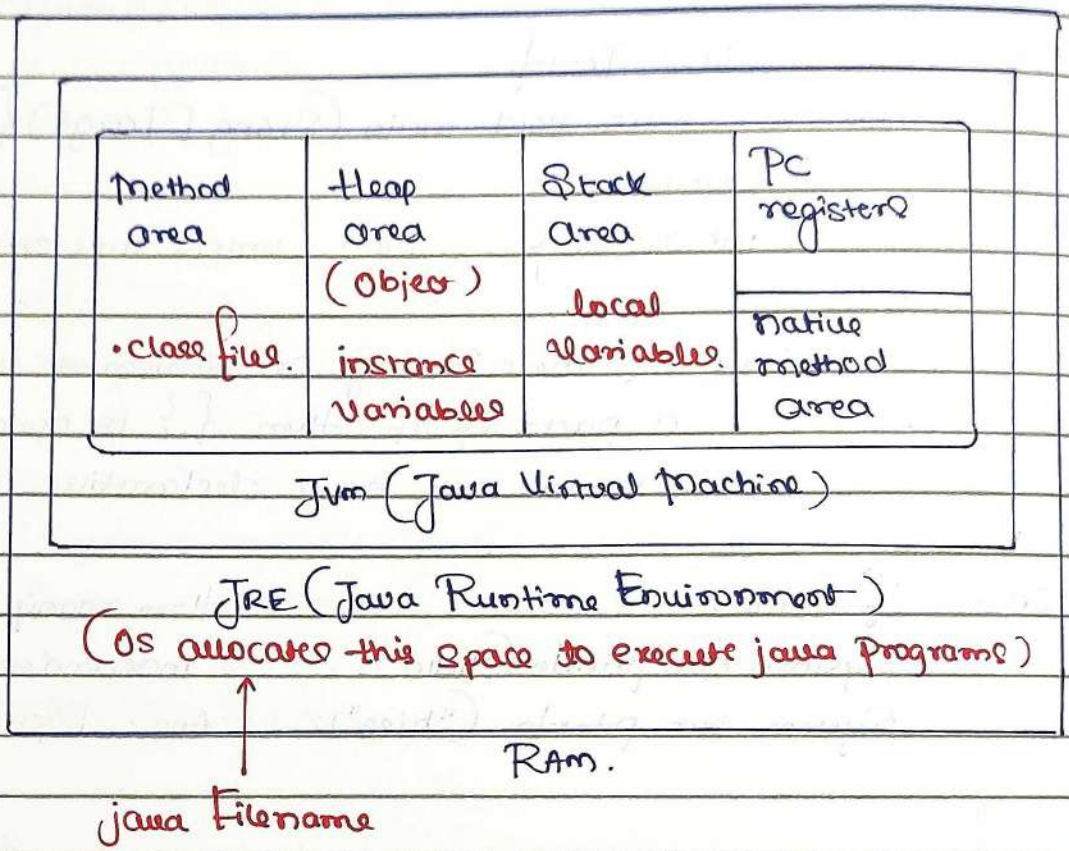
It is actually theory concept, which is implemented by many programming language like C++, java, python.... Any realtime problem can be solved if we solve oop's principle

In OOPs while solving the problem

1. We need to first mark the objects
2. Every object we mark should have 2 parts:
    a. HAS-part / attributes (store info. as variables)
    b. DOES-part / behaviours (represent them as models)
3. To represent an object, first we need to have a blueprint of an object.
4. We use "new" keyword / reserve word to create an object for blueprint.

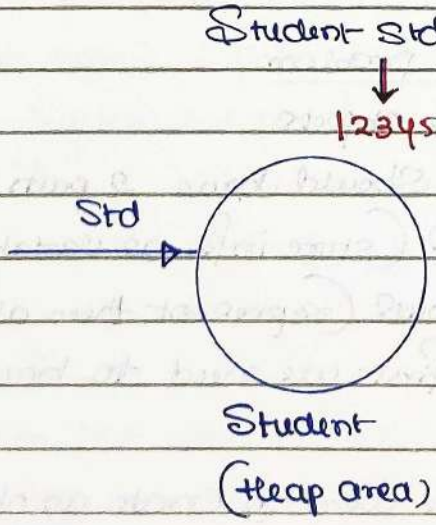
5. Every object should always be in constant interaction
6. Useless object doesn't exists.

Jvm architecture:



PC registers: address of next instruction which needs to be executed

Native method area: code of other languages which is required for java would be available here.



1. What is Object?
Physical existance of any element we say as Object.
eg: book, car, computer ...

2. What is "Has-part" and "Does-part" of an object represents?
Has part : indicates what it can hold.
Does part : indicates what it can do

3. What is blueprint in Java and how to represent it?
In Java to represent a blueprint we have a reserve word called "class".
Conventions followed by Java developers while writing a class is :
a.) Classname should be in "PascalConvention".
eg: InputStream, FileReader ...
b.) Variables are represented in "CamelCase".
eg: javaFullstack.
c.) methods are represented in "camelcase"

eg:
```
// Blue print of Student object
Class Student
{
  // HAS-part
  int Sid;
  String name;
  int age;
  Char gender;

  // DOES-part
  void play(){ }
  void study(){ }
}
```

* To create an Object in java we use "new" Keyword

Syntax:
Classname Variable = new ClassName();

new:
it is a signal to Jvm to Create Some Space for object in heap area.

new: It is a signal to Jvm to create some space for the Object in the heap area.

* Tell the ClassName, we inform the ClassName, Jvm Create the object and sends the "hashcode" to the user.
* User should collect the hashcode through "ref. variable"

Types of Variables:

Division 1 - Based on the type of value represented by a variable all variables are divided into 2 types:

1. Primitive variables: primitive variables used to represent primitive values. eg: int x=10;

2. Reference Variables: reference variables can be used to refer objects.
eg: Student s = new Student();

Instance Variables: if the variable is declared inside the class, but outside the methods such variables are called as "instance variables".

or

If the value of the variables changes from object to object then such variables are called as "instance variables".

When will the memory for instance variable be given?

Ans: Only when the object is created Jvm will create a memory and by default jvm will also assign the default value based on the datatype of variable.
eg: int - 0, float - 0.0f, boolean - false, char - ' ', String = null ...

Note: Scope of the instance variable would be available only when we have reference pointing to the object, if the object reference becomes null, then we can't access "instance variables".

eg:
```
public class Test{
    int i=10;
    public static void main(String[] args)
    { System.out.println(i); // CE: because instance variable can't
                                be accessed directly in static context.
      Test t= new Test(); // object stored in heap area.
      System.out.println(t.i);
      t.methodOne(); }

    public void methodOne()
    { // inside instance method instance variable can be directly
      accessed.
      System.out.println(i); // 10 because it is an instance variable
      }
}
```

Key points about instance variables:

* If the value of a variable is varied from object to object such type of variables are called instance variables.
* For every object a seperate copy of instance variables will be created.
* Instance variables will be created at the time of object creation and destroyed at the time of object destruction hence the scope of instance variables is same as scope of objects.
* Instance variables will be stored on heap as a part of object.
* Instance variables will be declared within the class directly but outside of any method or block or constructor.

* Instance variables can be accessed directly from instance area but cannot be directly accessed from Static area.
* But by Object reference we can access instance variables from Static area.

Local Variables:

1. Variables which are created inside the Stack area are called local variables.
2. During the execution of the method the memory for local variables will be given, and after the execution of the method the memory for variables will be taken out from the Stack.
3. Local variables default value will not be given by the JVM, programmer should give the default value.
4. If the programmer doesn't give default value and if he uses the variable inside the method then program would result in "CE".

eg:
```
public class Test
{
    public static void main (String[] args)
    {   int i=0;
        for (int j=0; j<3; j++){
            i=i+j;
        }
        System.out.println(j); } // CE: 'j' not declared.
}
```

eg2.
```
class Test
{   public static void main (String[] args)
    {   int x;
}       System.out.print("hello"); } // 'hello' because 'x' not used.
```

eg 3

```
Class Test
{ public Static void main(String [] args)
    { int x;
      System.out.println(x); } // CE: 'x' not initialised
}
```

eg 4.

```
Class Test
{ public Static void main (String [] args)
    { int x;
      if (args.length > 0) x=10;
      System.out.println(x); }
}
```

Keypoints of Local Variables:

* Sometimes to meet temporary requirements of the programmer we can declare variables inside a method or block or Constructor. Such type of variables are called local variables or automatic variables / temporary variables / stack variables.
* Local variables will be stored inside stack.
* The local variables will be created as part of the block execution in which it is declared and destroyed once the block execution completes. Hence scope of local variables is exactly same as scope of the block in which we declared.
* It is highly recommended to perform initialization for the local variables at the time of declaration atleast with default values.

Code Snippets:

1.
```
public class Test
{ public static void main (String args[])
  { int x=10;
    Switch (x)
  { System.out.println ("hello"); }
  }
}
```
Ans: Statement is not part of case label so CTE.

2.
```
public class Test
{ public static void main (String [] args)
  { int x=10;
    int y=20;
    Switch (x)
  { Case 10: System.out.println ("hello");
             break;
    Case y: System.out.println ("hiee");
            break; }
  }
}
```
Ans: Compile time error because case label is not constants.

* Label in Switch should be "compile time constants", meaning the value should be known to compiler.

3. In the above code ↑

```
int x=10;
final int y=20;
Switch (x)
{ Case 10: System.out.println ("hello");
           break;
  Case y: System.out.println ("hiee"); }}
```
Ans: "hello".

Note: "final" means compiler will get to know the value and compiler treats it as "Compile Time constant".

4.
```
{ int x = 10;
  Switch (x+1)
  { case 10:
    Case 10+20;
    Case 10+20+30: }
}
```
Ans: No output.

5.
```
byte x = 10;
Switch (x)
{ case 10: System.out.println("hello");
           break;
  Case 100: System.out.println("bree");
           break;
  Case 1000: System.out.println("byte");
           break; }
```
Ans: Compile time error because case value outside the range.

Note: Label value should be within the range of arge type otherwise it would result in "CE".

6.
```
byte x=10;
Switch (x+1) // byte + int → int, so Switch(int)
{ case 10: System.out.println("H");
           break;
  Case 100: System.out.println("Hi");
           break;
  Case 1000: System.out.println("No");
           break; }
```
Ans: No output.

7. int x = 97;
Switch (x)
{ case 97 : Print ("hi"); break;
case 'a' : Print ("100"); break; }
int x = 'a' x = 97.
And case label values can't be duplicated so "CE".

Methods in Java:

A method in Java is a block of code that when called performs specific actions mentioned in it.

Methods have 4 things:

1. Name
2. input (parameters)
3. Body
4. return type.

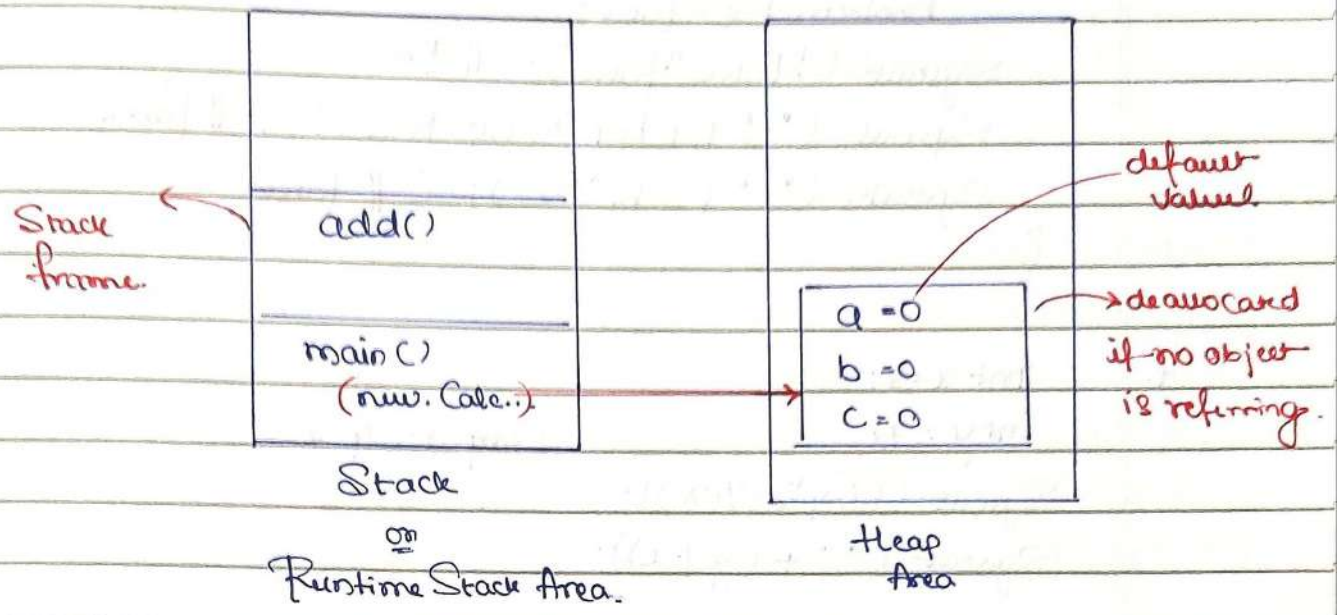
In my program if I have any task, I will write inside a method.

Task is present inside a method and if the task has to be executed it has to be brought into stack area. What will be there in Stack area only that part will be executed.

```
class Calculator
{ int a, b, c; // Instance var.
  void add()
  { a=10;
    b=20;
    c=a+b;
    System.out.println(c); }
}
```

```
public class Launch
{
  public static void main (String
      [] args)
  {
    Calculator calc = new Calculator();
    calc.add(); }
}
```

calling method.



Code Snippets :

1.
```
int x = ?
Switch (x)
{ default : Print("default");
  Case 0 : Print("0"); break;
  case 1 : Print("1");
  Case 2 : Print("2"); }
```

Note: replace x with 0, 1, 2, 3.

x = 0, out : 0

x = 1 out : 1 2

x = 2 out : 2

x = 3 out : default 0.

2.
```
Boolean b1 = true; // Wrapper Class.
boolean b2 = false;
boolean b3 = true;
if ((b1 & b2) | (b2 & b3) & b3)
    System.out.print("alpha");
if ((b1 = false) | (b1 & b3) | (b1 | b2)
    System.out.print("beta");
```

Ans: No output is produced

3.
```
Class Maybe
{ public static void main (String [] args)
    { boolean b1 = true;
```

```
boolean b2 = false;
Sysout (!false ^ false); // true
Sysout (" " + (!b1 & (b2 = true))); // false
Sysout (" " + (b1 ^ b2)); } // false
}
```

4.
```
int x = 5;
int y = 7;
Sysout (((y++) % x));
Sysout (" " + (y % x));
```
Output: 4 2

5.
```
Integer i = 42;
String s = (i < 40) ? "life" : (i > 50) ? "Universe" : "everything";
Sysout (s);
```
Ans: "everything".

6.
```
{ Integer x = 0;
Integer y = 0;
for (Short z = 0; z < 5; z++)
if ((++x > 2) || (++y > 2))
x++;
Sysout (x + " " + y); }
```
Ans: 8 2

Method Overloading

Method overloading in java is a feature that allows a class to have more than one method with the same name, but with different parameters.

Java supports method overloading through two mechanisms:

1. By changing the number of parameters
2. By changing the datatypes of parameters.

eg:

```
Class Calculator
{
  int add (int a, int b)
  { return a+b; }

  int add (int a, int b, int c)
  { return a+b+c; }

  float add (int a, float b)
  { return a+b; }
}
```

```
Void main ( )
{
Calculator calc
      = new Calculator();
int a=10, b=20, c=30;
float m=5.5;
Sysout (calc.add (10,20));
Sysout (calc.add (10,20,30));
Sysout (calc.add (20 a, m);
```

1. Can we overload main method in Java?

Ans Yes, we can overload main method however Jvm will call such a main method which accept "String [] args" as parameters.

eg:

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

   public static void main (int [] args)
   { System.out.println ("accepting args"); }
}
```

Output: "Yes"

Arrays in Java:

* Arrays are index based data structure to store large volume of data using single name (variable name)
* Arrays store homogenous type of data
* Arrays are treated as objects and allocated on heap.

Syntax:

```
int [] a = new int[10];        → 1D Array
```

'a' is an array of '10' integers.

```
int [] arr = new int[N];
```

```
int [][] arr = new int[3][4];   → 2D Array
```

* Jagged Array: Array where data is irregular.

eg:

Classes	Students
0	5
1	3
2	4.

```
{ int [][] arr = new int[3][];
  arr[0] = new int[5];
  arr[1] = new int[3];
  arr[2] = new int[4]; }
```

Code Snippets:

1.
```
public static void main (String [] args)
{ while (true); }
```
Ans: Infinite loop with no output

2.
```
{ while (true)
    int x = 10; }
```
Ans: CE because declarative statements are not allowed.

3.
```
while (true)
{ int x=10; }
```
Ans: Memory for x will be given 4 bytes during execution.

4.
```
while (true) { System.out ("hello"); }
System.out ("hi");
```
Ans: Unreachable code (Compile time error).

5.
```
while (false)
{ Sysout ("hello"); }
  Sysout ("hi");
```
Ans: Compile Time Error at line 1. (Unreachable code).

6.
```
{ int a=10, b=20;
  while (a<b)
  { Sysout ("hello"); }
    Sysout ("hi") }
```
Ans: 'Hello' will be printed infinite times

Note: Whenever variables are marked as final, compiler gets to know the values of those variables and it will use the values in the expression to get the result.

7.
```
{ final int a=10, b=20;
  while (a<b)
{ Sysout ("hello"); }
  Sysout ("hi"); }
```
Ans: Compile time error at line no 2

8.
```
{ do
    Sysout ("hello");
  while (true); }
```
Ans: hello infinite times.

9.
```
{ do
  while (true); }
```
Ans: Compile Time Error (there should be atleast on statement in loop)

10.
```
{ do;
  while (true); }
```
Ans: No output, Semi colon is a empty Statement.

11.
```
{ do while (true)
    Sysout ("hello");
  while (true); }
```
Ans: hello infinite times.

classmate
Date 9/2/23.
Page

Taking input from Console:

```
Scanner scan = new Scanner (System.in);
    int a = scan.nextInt();
                ( To take integer input.
```

Taking input in an array:

```
    int[] ar = new int[5];
Scanner scan = new Scanner (System.in);
for (int i=0; i<n; i++)
{  ar[i] = scan.nextInt(); }

for (int i=0; i<5; i++)
{  System.out.println (ar[i]); }
```

Making an array of objects.

```
Class Fan
{   int cost;
    String brand;
    int noOfWings; }

Public Class Launch
  {  public static void main (String [] args)
       {
          Fan [] f = new Fan[3];
       f[0] = new Fan();
       f[1] = new Fan();

          f[0].brand = "Vivek"; }
```

Disadvantages of Array:

* It can store only homogenous type of data.
* Memory of array is fixed in size, it cannot grow or shrink.
* Array demands contigous memory locations.

Enhanced / Advanced "for Loop":

eg.
```
int arr[] = {10, 20, 30, 40};
for (int x : arr)
{ System.out.println(x); }
```
} Syntax.

Output: 10
20
30
40

Code Snippets:

1.
```
do{
  Sysout("hello"); }
while (true);
  Sysout("hi");
```
Ans: Compile time error at line 2.

2.
```
do {
  Sysout("hello"); }
while (false);
  Sysout("hi");
```
Ans: hello
hi

3.
```
int i=0, j=0;
int i=0, Boolean b= true;
int i=0, int j=0;
```
How many statements are valid?
Ans: Only 1 statement is valid (first).

4.
```
int i=0;
for (Sysout("hello"); i<3; i++);
  { Sysout("no"); }
```
Ans: hello
hi (x3.)

Note: Syntax of for loop

```
for (Stmt 1; Stmt 2; Stmt 3)
  { Stmt 4; }
```

Stmt 1: Can be any Statement, but suggested for initialization
Stmt 2: Compulsorily should be a boolean Statement only.
Stmt 3: Can be any Statement, but suggested for inc/dec.
Stmt 4: Can be any Statement, suggested for repetative logic.

5.
```
int i=0;
for (Sysout("hello"); i<3; Sysout("hi"))
  { i++; }
```
Ans: hello
hi x3.

6.
```
for (;;)
  { Sysout("hello"); }
```
Ans: "hello" infinite times
Boolean value/Statement will be evaluated as true if empty.

7.
```
for (int i=0; true; i++)
  { Sysout ("hello"); }
Sysout ("second");
```
Ans: Compile time error at line 2

8.
```
for (int i=0; false; i++)
  { Sysout ("hello"); }
Sysout ("second");
```
Ans: Compile time error at line no. (Code unreachable).

Note: * If a variable marked as final, then those values are known to compiler so we say them as "Compile time constants".

* If a variable is marked as final, then the value for those variables should never be changed in the program, if we try to do we will result in "Compile time error".

* In Java memory for a variable is given by JVM as per its datatype specification and value also will be assigned by JVM only, compiler will not allocate memory for the variables and it will not initialize the value for the variable

eg:

```
final int a=10;
a++;          // CE: value can't be reassigned.
Sysout(a);
```

Enhanced for loop for 2D arrays.

eg.

```
int[][] a={ {10,20}, {30,40,50}, {60,70,80,90} };

for(int ar[]:a)
{   for(int elem:ar)
    { System.out.print(elem+" "); }

    System.out.println(); }
```

Output:
10 20
30 40 50
60 70 80 90

Limitations of Enhanced for loop:

1. We cannot access a particular element at index and modify it.
2. Traverse/iterates only in forward direction
3. We cannot traverse alternative indexes or skip certain indexes.

Syntaxes for arrays:

```
int []x;  ✓        int[]x;  ✓        int[6]ar;  x
x=new int[4]; ✓    int x[]; ✓        int []ar[]; ✓
int []aa, []bb;  x
int []aa, bb[][];  ✓  aa=1D, bb=2D
```

Note:

Size can be:

int [] a = new int[5]; → byte, short, int, char ✓

↓ size. → long, float, double, boolean ✗

* Range in an array is upto the range of "int" not beyond it.
* There are many methods in Array class like Sort, fill, binary-Search etc.
* All these methods are Static methods which means we do not need to create objects to call methods, we call the methods directly.

eg: Arrays.Sort();

```
int arr[] = {70,80,90};
Arrays.sort(arr); // Sorts the array
```

Code Snippets

1.
```
int x=0;
Switch(x){
  Case 0: Sysout("hello"); break;
  Case 1: Sysout("hi"); }
```
Ans: hello

2.
```
for(int i=0; i<10; i++)
{ if(i==5) break;
  Sysout(i); }
}
```
Ans: 0 1 2 3 4

3.
```
int x=10;
l1: { Sysout("begin");
    if(x==10) break l1;
    Sysout("end"); }
Sysout("hello");
```
Ans: begin
hello

4. int x=10;
if (x==10) break;
Sysout ("hello");

Ans: Compile time error because break is used without Switch/loop.

5. int x=2;
for (int i=0; i<10; i++)
{ if (i%x==0) continue;
Sysout (i); }

Ans: 1 3 5 7 9

6 int x=10;
if (x==10) continue;
Sysout ("hello");

Ans: Compile time error.

7. int x=0;
Switch (x)
{ case 0: Sysout ("hello"); continue;
case 1: Sysout ("hi"); }

Ans: Compile time error
- continue can be only used in loops and labelled blocks.

8. if(true) Sysout("hello");
else Sysout ("hi");

Ans: hello.
Concept of unreachability holds good only for loops.

Binary Search

Binary Search is one of searching techniques applied when input is sorted

```
public class BinarySearch
{
    public static void main (String [] args)
    { int arr[] = {10, 20, 30, 40, 50};
      Scanner scan = new Scanner (System.in);
      System.out.println ("Enter the key");
```

```
int key = scan.nextInt();
int low = 0;
int high = arr.length-1;
while (low <= high)
{   int mid = (low+high)/2;
    if (key == arr[mid])
    { System.out.println("Key found");
      break; }

else if (key < arr[mid]) high = mid-1;
else if (key > arr[mid]) low = mid+1; }

if (low > high) System.out.print("key found"); }
```

Arrays Class.

```
Public class AC
{ public static void main (String [] args)
  { int [] a = new int [4];

    Arrays.fill (a, 5); // Fills '5' in every index
    Arrays.fill (a, 2, 5, 9); // Fills '9' from index 2-4

    Arrays.sort (a); // Sorts the array
  int res = Arrays.binarySearch (arr, 10);
    // Searches for '10' in the sorted array & returns
       index, if not found returns negative index.
  }
```

Code Snippets

1.
```
int x=0;
do{
    ++x;
   Sysout(x);
   if (++x<5) continue;
    ++x;
   Sysout(x); }
while (++x<10);
```
Ans: 1 4 8 6 10

2.
```
for (int i=0; i++<5; i++)
  { Sysout ("hello");
      i=i++; }
```
* How many times hello printed?

Ans: 3 times

↑ assignment and increment to same variable, increment does not have any scope, so increment doesn't happen.

3.
```
int i=5;
Sysout (i+++" ");
Sysout (i+" ");
Sysout (++i+" ");
Sysout (++i+i+++" ");
```
Ans: 5 6 7 1 6

4.
```
int [] a = {0,2,4,1,3};
for (int i=0; i<a.length; i++)
    a[i] = a[(a[i]+3)/a.length];
    Sysout(a[i]);
```
Ans: 2.

5.
```
int i=0; j=5;
for (; (i<3) and (j++<10); )
{ Sysout (" " + i + " " +j); i++; }
  Sysout (i+" "+j);
```
Ans: 0 6 1 7 2 8 3 8

6. for (int i=0; i<10; i+=2);
   Sysout (i); Ans: 02468

7. int x=5;
   x* = 3*5 + 7*x-1 + ++x; Ans: 275.
   Sysout (x);
   ↑ assignment and incrementation to the same variable, so incrementation has no scope.

8. int a = 3;
   Switch (a)
   { Case 1: ++a; Ans: 5
     Case 2: a++; Case 3 and default both are executed as no break statements are available.
     Case 3: a++;
     default: ++a; }
   Sysout (a);

9. int i;
   for (i=0; i<6; i++) Ans: 7
   { if (++i>3) continue; }
     Sysout (++i);

Bubble Sort.

```
Public Class LaunchBS
{ Public Static void main (String [] args)
    { int [] a = { 7, 5, 2, 3, 1, 4, 6 }
  for (int i=0; i<a.length; i++)
  { for (int j=1; j<a.length-i; j++); { pushing the large element to last
      { if (a[j] < a[j-1])
          swap (a[j], a[j-1]); } } by swapping.
  }
```

Guesser Game Assignment.

```
import java.util.*;
class Guesser
{  int guessNum;
   int guessNum()
   {  Scanner scan = new Scanner (System.in);
      System.out.println ("Guess the number");
      guessNum = scan.nextInt();
        return guessNum; }
   }
```

```
Class Player
{   int guessNum;
    int guessNum()
   {  Scanner scan = new Scanner (System.in);
      System.out.println (" Player's Guess");
      guessNum = scan.nextInt();
       return guessNum; }
   }
```

```
Class Umpire
 {  int numFromGuesser;
    int numFromPlayer1;
    int numFromPlayer2;

    void collectNumFromGuesser()
    {  Guesser g = new Guesser();
       numfromGuesser = g.guessNum(); }

    void collectNumFromPlayers()
    {  Player p1 = new Player();
```

```
Player p2 = new Player();
numFromPlayer1 = p1.guessNum();
numFromPlayer2 = p2.guessNum(); }

void compare()
{
    if (numFromGuesser == numFromPlayer1)
    {
        if (numFromGuesser == numFromPlayer1 && 2)
            System.out.println("All players won");

    else if (numFromGuesser == numFromPlayer2)
            System.out.println("Player 1 and 2 won");

    else if (numFromGuesser == numFromPlayer3)
            System.out.println("Player 1 and 3 won");

        else
            System.out.println("Player 1 won"); }

    else if (numFromGuesser == numFromPlayer2)
{
    if (numFromGuesser == numFromPlayer3)
            System.out.println("Player 2 and 3 won");

        else
            System.out.println("Player 2 won"); }

    else if (numFromGuesser == numFromPlayer3)
    {
        System.out.println("Player 3 won"); }
```

```
else
  { System.out.println("Game lost, Try Again!"); }

Public class LaunchGame
{
  Public Static void main (String args[])
    {
      Umpire u = new Umpire();
      u.CollectNumFromGuesser();
      u.CollectNumFromPlayers();
      u.Compare(); }
}
```

String in Java

* It is a classname, String is basically an inbuilt class for which object can be created.
* String refers to collection of characters.

Eg: Syntax:

```
String s1 = "Sachin";
System.out.println(s1);
```

* Strings with and without 'new'.

```
String s2 = new String("Sachin");
```

Immutable (no change)	Mutable (change)
1. String (c)	1. StringBuffer
	2. StringBuilder (1.5v)

In Java String object is by default immutable, meaning once the object is created we cannot change the value of the object, if we try to change then those changes will be reflected on the new object not on the existing project.

Case 1:

```
String s = "Sachin";
s.concat ("tendulkar"); // new Object of string got created in heap area "Sachintendulkar" so immutable, the new object gets collected by garbage Collector.
System.out.println (s);
```

Output: Sachin

VS

```
StringBuilder sb = new StringBuilder ("Sachin");
sb.append ("tendulkar"); // on same object modification so mutable.
System.out.println (sb);
```

Output: Sachintendulkar

Case 2:

```
String s1 = "Sachin";
String s2 = new String ("Sachin");

System.out.println (s1==s2); // false because they are two different objects.
System.out.println (s1.equals(s2)); // true.
```

String class.equals method will compare the content of the object, if returns true if same else false.

V/S

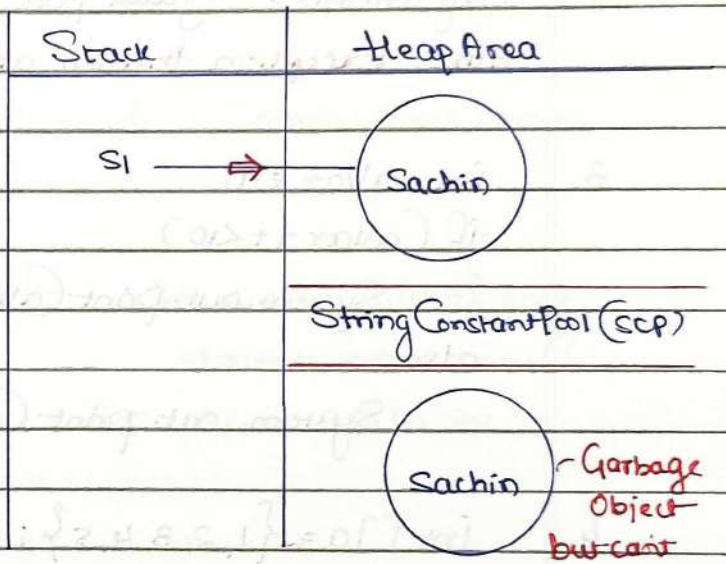
```
StringBuilder s1 = new StringBuilder("sachin");
StringBuilder s2 = new StringBuilder("sachin");

System.out.println(s1==s2); // False
System.out.println(s1.equals(s2)); // False
```

StringBuilder Class equals() compare the reference (address of object) not the content of StringBuilder

Case 3:

```
String s1 = new String("sachin");
```

In this case two objects will be created one in heap and another one in String Constant Pool, the reference will always point to heap.



v/s

```
String s="sachin"
```

In this case only one object will be created in the String Constant Pool and it will be referred by our reference.

Code Snippets

1.
```
int a=7;
boolean res = a++ ==7 && ++a==9 || a++==9;
Sysout("a = " + a);
Sysout("res = " + res);
```
Ans: a=9, res = True.

2.
```
if (args.length==1 | args[1].equals("test"))
    Sysout("test case");
else
    Sysout("production " + args[0]);
```
Arguments: java Fork live2
Ans: Exception thrown at runtime (array index out of bounds).

3.
```
int aVar = 9;
if (aVar++<10)
    System.out.print(aVar + "Hello World!");
else
    System.out.print(aVar + "Hello Universe!");
```
Ans: 10 Hello World!

4.
```
int [] a = {1,2,3,4,5};
for (x)
  { System.out.println(a[e]); }
```
→ What can u replace with x to print 135?
Ans: int e=0; e<5; e+=2;

5.
```
int num=5;
do
  { System.out.println(num-- + " "); }
while (num==0);
```
Ans: 5

6. int ii = 0;
int jj = 7;
for (int ii = 0; ii < jj - 1; ii = ii + 2;)
{ Sysout (ii); }
Ans: 0, 2, 4.

7. arr[0] = 10;
arr[1] = 20;
Sysout (arr[0] + ":" arr[1]);
→ Which code fragment should be kept first to print 10:20?
Ans: int arr;
arr = new int[2];

8. boolean opt = true;
Switch (opt)
{ Case true: Sysout ("true");
break;
default: Sysout ("***"); }
Sysout ("Done");
Note: Switch (args.)
args can be: byte, short, int, char, String, enum.
Ans: Compile time error.

9. int intArr[] = {15, 30, 45, 60, 75};
intArr[2] = intArr[4];
intArr[4] = 90;
What are values of each element in the array?
Ans: 15 30 75 60 90

10. int x;
Sysout ("hello");
Ans: hello.

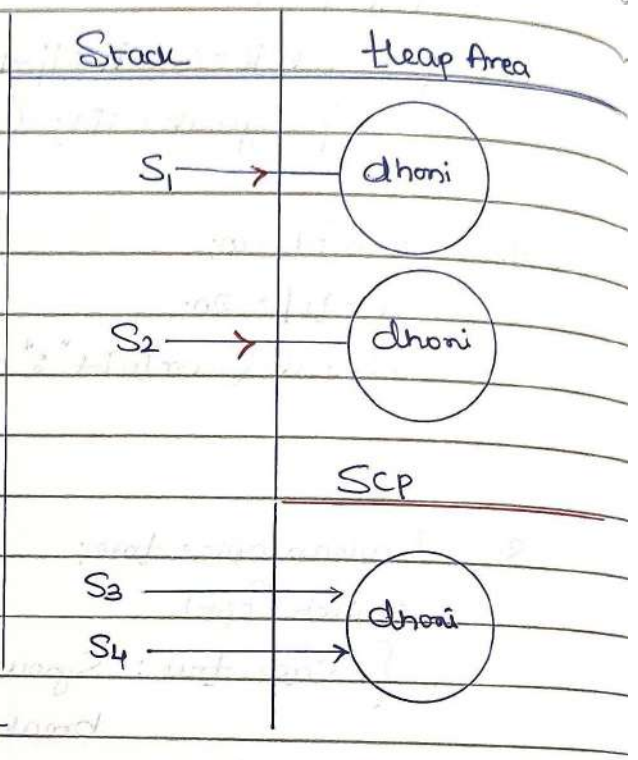
11. int x;
Sysout (x);
Ans: Compile time error (x is not initialised).

12. int x;
if (args.length > 0) x = 10;
Sysout (x);
Ans: Compile time error, because in case if condition fails then what would be the value of 'x'. So JVM will give error.

Strings (Continued)

eg1.

```
String s1 = new String("dhoni");
String s2 = new String("dhoni");

System.out.println(s1==s2); // False
String s3 = "dhoni";
String s4 = "dhoni";

System.out.println(s3==s4); // True
```

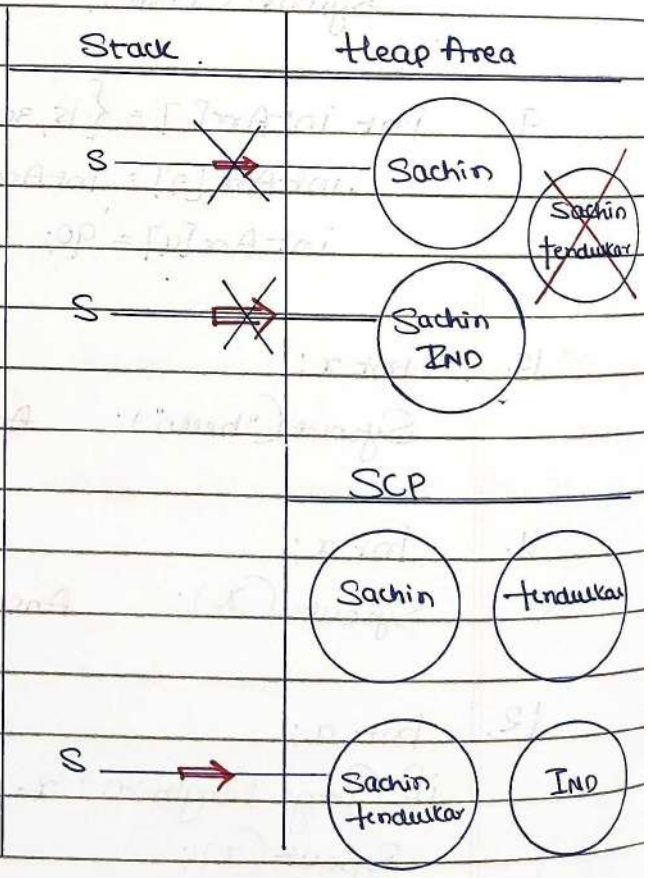


Note: * duplicates allowed in Heap Area and not in SCP

* Memory will be cleared at the time of Jvm shutdown.

eg2

```
String s = new String("sachin");
s.concat("tendulkar");
s = s.concat("IND");
s = "sachintendulkar";
System.out.println(s); // sachintendulkar
```

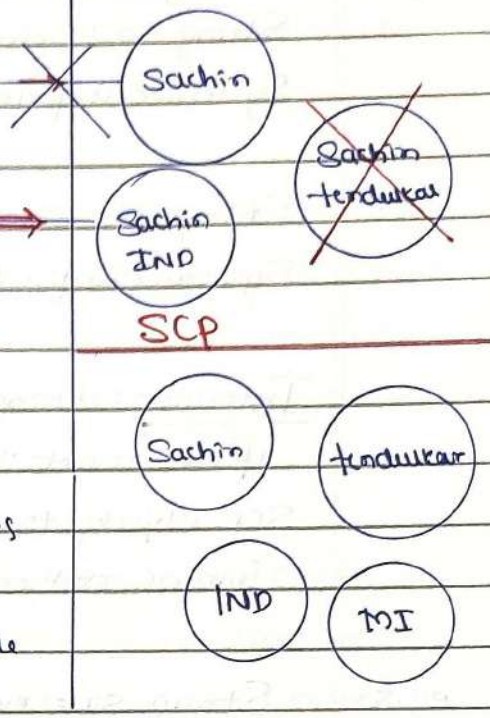


Note: Direct literals are always placed in SCP, because of runtime operation if object is required to create compulsorily that object should be placed on heap, but not on SCP.

eg:-

```
String s1 = new String ("sachin");
s1.concat ("tendulkar");
s1 += "IND";
String s2 = s1.concat ("MI");
System.out.println (s1); // sachin IND
System.out.println (s2); // sachin INDMI.
```

Stack. | Heap Area



s2 → Sachin INDMI

(Stack) (Heap A)

Note: String + "IND"

→ addition if one operand is string then it causes concatination.

* Total 8 objects created and 2 are eligible for garbage collection.

Q1.

```
String s1 = new String ("you cannot change");
String s2 = new String ("you cannot change");
System.out.println (s1 == s2); // false
```

```
String s3 = "yo Cannot Change";
System.out.println (s1 == s3); // false
String s4 = "you Cannot Change";
System.out.println (s3 == s4); // true
```

```
final String s8 = "you Cannot ";
String s9 = s8 + "Change";
System.out.print (s3 == s9);
// true
```

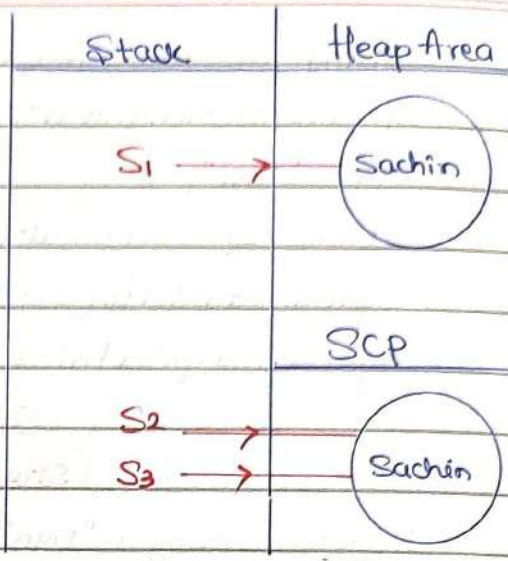
```
String s5 = "you Cannot " + "Change";
System.out.println (s3 == s5); // true
```

```
System.out.print (s6 == s8);
// true
```

```
String s6 = "you Cannot";
String s7 = s6 + "Change";
System.out.println (s3 == s7); // false
```

eg4.

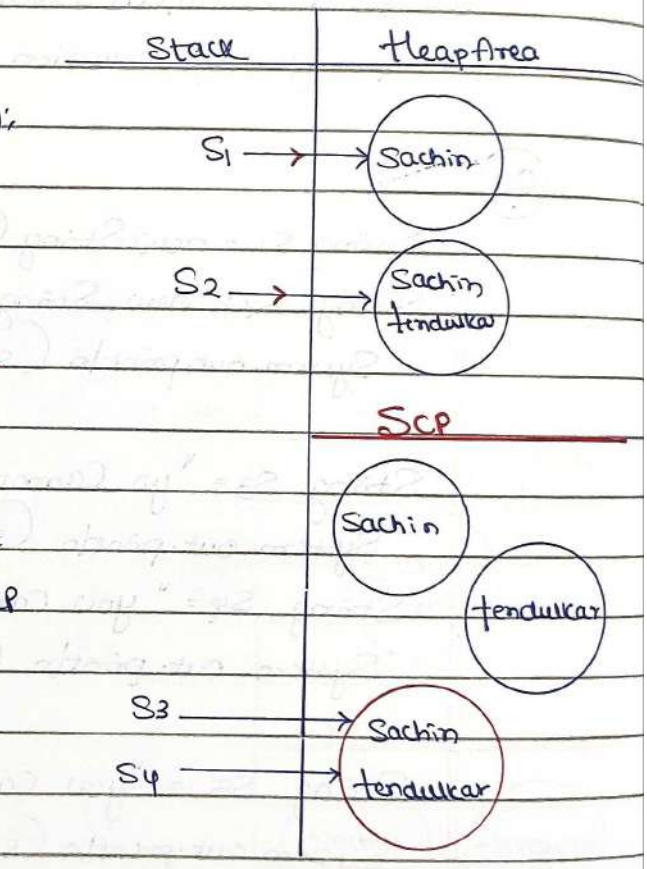
```
String s1 = new String("sachin");
String s2 = s1.intern();
System.out.println(s1==s2);

String s3 = "sachin";
System.out.println(s2==s3)
```



Interning: Using heap object reference, if we want to get corresponding SCP object, then we need to use intern() method.

eg.5

```
String s1 = new String("sachin");
String s2 = s1.concat("tendulkar");

String s3 = s2.intern();
String s4 = "Sachintendulkar";
System.out.println(s3==s4); // true
```



Note:

Using heap object reference, if we want to get the corresponding SCP object and if object does not exists, their intern() will create a new object in SCP & returns it.

Importance of SCP:

(1.) In our program if any String object is required to use repeatidely then it is not recommended to create multiple object with same content it reduces performance of the system and affects memory utilization.

(2) We can create only one copy and we can reuse the same object for every requirement. This approach improves performance and memory utilization, we can achieve this by using "scp".

(3) In SCP several references pointing to same object, the main disadvantage in this approach is by using one reference if we are performing any change the remaining references will be impacted. To overcome this problem immutability concept for String Objects was introduced.

(4) According to this once we create a String object we can't perform any changes in the existing object if we are trying to perform any change a new String object will be created hence immutability is the main disadvantage of SCP.

String Class Constructor (commonly used)

String s = new String() → Creates an empty String object

String s = new String(String Literals) → Creates an object with String Literals on heap.

String s = new String(StringBuffer sb) → Creates an equivalent String object for string buffer.

String s = new String(char ch[]) → Creates an equivalent String object for character array

String s = new String(byte[] b) → Creates an equivalent String object for byte array

eg:

```
char[] ch = {'j','a','v','a'};
String s1 = new String(ch);
System.out.println(s1);
// java
```

```
byte[] b = {65, 66, 67, 68};
String s2 = new String(b);
System.out.println(s2);
// ABCD
```

Important methods of String

1. Char charAt(int Index)
2. String concat (String str)
3. boolean equals (Object o)
4. boolean equalsIgnoreCase (String s)
5. String subString (int begin)
6. String subString (int begin, int end)
7. int length()
8. String replace (char old, char new)
9. String toLowerCase()
10. String toUpperCase()
11. String trim() — remove first and last blank space.
12. int indexOf (char ch)
13. int LastIndexOf (char ch)

eg: String s = new String ("Sachin");
System.out.print (s[3]); //CE because in java String is an object and accessing prohibited

System.out.print (s.charAtIndex(3)); //h

System.out.print (s.charAtIndex(-1)); // String index out of bounds exception.

Note:

package java.lang; Class String { Public int length() { } }.	Integer Array Class. Class [I { int length; }	s.length() method of String class array.length. property of array class.

Code Snippets

1.
```
int n[][] = {{1,3},{2,4}};
for(int i=n.length-1; i>=0; i--)
  { for(int y : n[i])
      Sysout(y); }
```
Ans: 2 4 1 3

2.
```
int nums1[] = {1,2,3};
int nums2[] = {1,2,3,4,5};
 nums2 = nums1; // Compiler for array assignment compiler
for(x : nums2)   will check only the type not length.
  Sysout(x+" ");
```
Ans: 1 2 3

3.
```
int data[] = {2010, 2013, 2014, 2015, 2014};
 int key = 2014; int count=0;
for(int e:data)
  { if(e!=key)
      { continue; count++; }
  }
 Sysout(count+"found");
```
Ans: 0 found ×
Compile time error because "count++" is unreachable code.

4.
```
int numbers[];
 numbers = new int[2];
numbers[0]=10; numbers[1]=20;
numbers = new int[4]; // new object created
numbers[2]=30; numbers[3]=40;
for(int x:numbers)
   Sysout(" "+x);
```
Ans: 0 0 30 40

5.
```
String days[] = {"sun", "mon", "wed", "sat"}; int wd=0;
 for(String s: days)
  {
```

```
Switch (s)
{ Case "Sat" :
  Case "Sun" ; wd -= 1;
               break;
  Case "mon" : wd++;
  Case "wed" : wd+=2; }   Ans : 3.
}
```

6.
```
String [] str = {"A", "B"}
int idx=0;
for (String s : str)
{ str[idx].concat("element"+idx);
    idx++; }
for (idx=0; idx<str.length(); idx++)
  { System.out.length (str[idx]); }   Ans : AB.
```

Strings (Continued)

Q1.
```
String s1 = "Sachin";        s1, s3 → "Sachin" (SCP)
String s2 = s1.toUpperCase(); // s2 → "SACHIN" (Heap Area)
String s3 = s1.toLowerCase();

System.out.println (s1==s2); // false
System.out.println (s1==s3); // true.
```

Q2.
```
String str = " ";
str.trim();
System.out.println (str.equals("") + " " + str.isEmpty());
// false false (because immutable)
```

Note: Whenever we print any reference, by default JVM will call "toString()" on the reference.

eg: Class Student
{ String name = "sachin";
int id = 10; }

In main {
Student Std = new Student();
System.out.println(std); }

Out: Student@HexValue.

eg6 final StringBuffer sb = new StringBuffer("sachin");
sb.append("tendulkar");
System.out.println(sb); // sachin-tendulkar

Content of StringBuffer can be changed because it is mutable even with final keyword.

sb = new StringBuffer("kohli");
↑ sb if final can't be reused, Sb can't point to new object, because it's final

final v/s immutability

* final is a modifier applicable for variables, where as immutability is only applicable for objects.
* If reference variable is declared as final, it means we cannot perform re-assignment for the reference variable, it does not mean we cannot change/perform any change in that object.
* By declaring the reference variable as final, we won't get immutability nature.
* final and immutability are different concepts.

Note:

final variable ✓	immutable variable ✗
final object ✗	immutable object ✓

* StringBuilder, StringBuffer and all Wrapper classes (Byte, Short, Long, Integer, Float, Double, Boolean, Character) are by default mutable.

Important methods of StringBuffer / StringBuilder

1. int length()
2. int capacity()
3. char charAt(int index)
4. void setCharAt(int index, char ch)
5. StringBuffer append(String s)
6. StringBuffer append(int i)
7. StringBuffer append(long l), [boolean, double, float]
8. StringBuffer append(int index, Object o) (overloaded)
9. StringBuffer insert(int index, String s) [int, long, doub, bool, float] (overloaded)
10. StringBuffer delete(int begin, int end);
11. StringBuffer deleteCharAt(int index)
12. StringBuffer reverse()

Constructors of StringBuffer

StringBuffer sb = new StringBuffer();

→ Creates an empty StringBuffer object with default initial capacity of 16. Once StringBuffer reaches its maximum capacity a new StringBuffer object will be created

new capacity = (current capacity + 1) * 2;

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eg:

```
StringBuffer sb1 = new StringBuffer(19);
System.out.println(sb1.length()); //0
System.out.println(sb1.capacity()); //19
```

StringBuffer sb = new StringBuffer(String s);
It creates a string buffer object for the given String with the capacity = s.length() + 16.

Code Snippets:

1.
```
String [] arr = {"A", "B", "C", "D");
for(int i=0; i<arr.length; i++)
{ System.out.print(arr[i] + " ");
    if(arr[i].equals("C"))
        continue;
    System.out.println("work done");
    break; }
```
Output: A Workdone

2.
```
String [] str = new String[2];
int idx=0;
for(String s:str)
{ str[idx].concat("element"+idx);
    idx++; }
for(idx=0; idx<str.length; idx++)
    System.out.print(str[idx]);
```
Output: Null Pointer exception

3.
```
StringBuffer sb = new StringBuffer("java");
String s = "java";
if(sb.toString().equals(s.toString()));
    System.out.println("matched");
```
Output: Matched

```
else if (sb.equals(s))
    Sysout("match 2");
else
    Sysout ("No-match");
```

4. int[]a = new int[]? What is the array size?
Ans: Compile time error

5. int[]a = new int[0]
Ans: Code compiles fine.

6. int[]a = new int[-5]; Size of the array?
Ans: Array index out of the bounds exception is occured

7. Long x = 42L, y = 44L;
Sysout (" "+7+2+" "); // 72
Sysout (foo()+x+5+" "); // foo425 (because '+' with String is always concatenation)
Sysout (x+y+foo());

Static String foo()
{ return "foo"; }

x+y results in addition and then concatenation → 86foo.

Strings (Continued)

* void setLength(int length)

→ It is used to consider only the specified no. of characters and remove all the remaining characters.

eg: StringBuffer sb = new StringBuffer("sachinramesh");
sb.setLength(6);
System.out.println(sb); // Sachin

* void trimToSize()

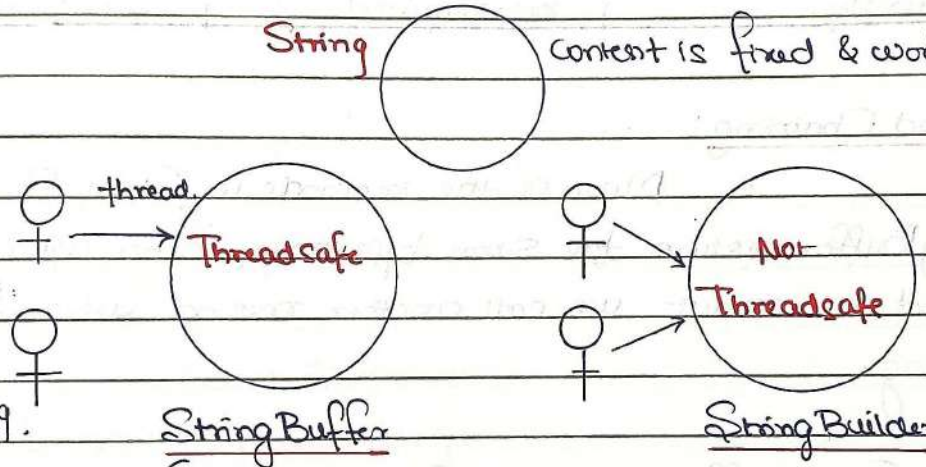
→ this method is used to deallocate the extra allocated free memory such that capacity and size are equal.

eg:

```
StringBuffer sb = new StringBuffer(1000);
sb.capacity(); // 1000    sb.append("sachin"); // 1000 (capacity)
sb.trimToSize();
System.out.print(sb.capacity()); // 6
```

* void ensureCapacity(int capacity)

→ it is used to increase the capacity dynamically based on our requirement



StringBuffer (Synchronized)	StringBuilder (1.5v)
→ Content is not fixed and it changes frequently and not worried about performance.	→ Content is not fixed and it changes frequently and worried about performance

Every method present in StringBuffer is synchronized, so at a time only one thread are allowed to operate on StringBuffer object, it would create performance problems, to overcome this problem we should go for StringBuilder.

StringBuilder (1.5v) : Same as StringBuffer (1.0v) with few differences.

StringBuilder:

* No methods are Synchronized.

* At one time more than one thread can operate so it is not threadsafe.
* Threads are not required to wait so performance is high.
* Introduced in jdk 1.5 version.

String	StringBuffer	StringBuilder
We opt if the content is fixed and it wont change frequently.	We opt if content changes frequently but threadsafety not required	We opt if content changes frequently but threadsafety is not required.

Method Chaining:

Most of the methods in String, StringBuilder, StringBuffer return the same type only, hence after applying method on result we call another method which forms method chaining.

eg: StringBuffer sb = new StringBuffer();
sb.append("sachin").insert(6, "tendulkar").reverse().append("IND").delete(0,4).reverse();
System.out.println(sb); // INDsachintendu

Program: Copy one String to another.

```
String s1 = "iNeuron", s2 = "";
for (int i=0; i<s1.length(); i++)
    { s2 = s2 + charAt(i); }
System.out.println(s2); // iNeuron
```

Program : Uppercase a String without inbuilt methods.

```
String s1 = "ineuron";
String s2 = "";
for (int i=0; i<s1.length(); i++)
{ s2 = s2 + (char) (str1.charAt(i)+32); }
System.out.println(s2);
```

Program : Reverse a String without inbuilt methods.

```
String s1 = "iNeuron";
String s2 = "";
for (int i = s1.length(); i>=0; i--)
{ s2 = s2 + s1.charAt(i); }
System.out.println(s2);
```

Code Snippets:

1.
```
String s = "SACHIN TENDULKAR";
int length = s.trim().length();
System.out.println(length); // 16
```

2.
```
String s = "Hello World";
s.trim();
int i = s.indexOf(" ");
System.out.println(i);
```
Ans : 5

3.
```
String s1 = "Java";
String s2 = new String("Java");
```

To print equal which code fragment should be added?

Ans : s1 = s2 } A
if (s1 == s2) }

sysout("equal");
else sysout("not equal");

– if (s1.equalsIgnoreCase(s2)) } B

4. System.out.println(" " == ""); - true
Sysout.println(" "); -
System.out.println("A" == "A"); - true
System.out.println("a" == "A"); - a == A (because both in double q's)

5. String str = "Java Rocks!";
Sysout (str.length() + ":" + str.charAt(10));
Ans: 11 : !

6. String s1 = "OCA";
String s2 = "oCa";
Sysout (s1.equals(s2)); Ans: false

7. String fName = "James", lName = "Gosling";
Sysout (fName = lName);
Ans: "Gosling" because it is assigned (no CE).

8. String str = "Good";
change (str);
Sysout (str);

Public static void change (String s)
{ s.concat ("-Morning"); }

Ans: Good.

9. StringBuilder sb = new StringBuilder ("Good");
change (sb);
Sysout (sb);

void change (String s)
{ s.append ("-Morning"); }

Ans: Good-Morning.

10. String str1 = new String ("Core");
String str2 = new String ("CoRe");
Sysout (str1 = str2);
Ans: CoRe.

11.
```
Public class Test
{  public String toString()
   { return "TEST"; }
}
Public Static void main (String[] args)
  { Test obj = new Test();
    Sysout(obj); }
}
```
Ans: TEST

12.
```
String S1 = "OCAJP";
String S2 = "OCAJP";
Sysout (S1 == S2);
```
Ans: true

13.
```
final String fName = "James";
String lName = "Gosling";
String Name1 = fName+lName, Name2 = fName + "Gosling";
String Name3 = "James" + "Gosling";
Sysout (Name1 == Name2); Sysout (Name2 == Name3);
```
false true.

String Programming:

Program: Check if a string is a palindrome or not.

```
String S1 = "NITIN", S2 = "";
for (int i = S1.length()-1; i>=0; i--)
 { S2 = S2 + S1.charAt(i); }
if (S1.equals(S2))
      System.out.println("Yes");
else
      System.out.println ("NO");
```

Program : Check for Angram between two strings

```
String s1="Race", s2="CarE";
s1 = s1.toLowerCase();
s2 = s2.toLowerCase();
Char [] = ch1 = s1.toCharArray();
Char [] ch2 = s2.toCharArray();

Arrays.sort(ch1); Arrays.sort(ch2);
if (Arrays.equals(ch1, ch2))
    System.out.println("Its Anagram");
else
    System.out.println("Its Not");
```

Program : Check for Pangram

```
String s1 = "The quick brown fox jumps over a the lazy dog";
 s1 = s1.replace(" ", "");
Char [] ch = s1.toCharArray();
 int [] ar = new int [26];      boolean flag = false.

for (int i=0; i<=ch.length-1; i++)
 {   int index = ch[i]-65;
     ar[index]++; }

for (int i=0; i<ar.length; i++)
 {   if (ar[i]==0)
     {  System.out.println("Not pangram");
        flag = true; break; }
 }
 if (flag == false) System.out.println("Its panagram");
```

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Encapsulation in Java:

* Data hiding
* Data binding
* Providing Security
* Providing Controlled access to data members.

Code.

```
Class Student
{
    Private int age;          // instance variables / data members
    Private String name;      // private members can be only accessed
    private String City;      inside the class.

    void SetAge (int age)     // Setter
    { this.age = age; }

    int getAge ()             // getter
    { return age; }

    void SetName (String name)
    { this.name = name; }

    voi String getName()
    { return name; }

    void SetCity (String City)
    { this.City = City; }

    String getCity()
    { return City; }
}
```

Note:

→ If a method is doing the activity of setting a value or data to it's class variable. (recieving data from outside) then it is called "Setter."

→ Such a method whose sole purpose is to return its value to whoever calls the method, we called it as "getters".

```
Public Class LaunchEncap
{
  Public Static void main (String [] args)
  {
    Student st = new Student();

    st.age = 28; // Compiler error because age is private.
    st.SetAge (28); // valid

    int age = st.getAge();
    System.out.println (age); // 28

    st.SetName ("Hyder");
    System.out.println (st.getName()); // Hyder }
}
```

Code Snippets :

1.
```
int mask=0, count=0;
if ( ((5<7) || (++count<10)) | mask++<10 ) mask = mask+1;
if ( (6>8)^ false ) mask = mask+10;
if ( !(mask>1)&& ++count>1 ) mask = mask+100;
Sysout (mask+" "+count);
```
Ans : 2 + 0

2.
```
int [] a = new int[3];
System.out.println (a);   // [I@ ... } address
System.out.println(a[0]); // 0
```

3. `int[][] a = new int[3][2];`
`System.out.println(a);` `System.out(a[0]);` `System.out(a[0][0]);`
↳ [[I@... ↳ [I@... ↳ 0

4. `int[][] a = new int[2][];`
`System.out(a);` `System.out(a[0]);` `System.out(a[0][0]);`
↳ [[I@ ↳ null ↳ Null Pointer Exception

5. `int[][] a = new int[3][2];` How many objects are created and how many are eligible for garbage collection?
`a[0] = new int[3];`
`a[1] = new int[4];`
`a = new int[4][3];` Objects created: 11, GC-6

6
```
int[] a;
main( )
{ Test t1 = new Test();
    System.out(t1.a); // Null
    System.out(t1.a[0]); } // Null pointer exception.
```

7. `int[] a = new int[3];` // declared at instance level
`System.out.println(obj.a);` // null
`System.out(obj.a[0]);` // Array index out of bounds exception.

8. `int[] a;` // can't be used without initialised (local variable).
`System.out(a);` `System.out(a[0]);`
Ans: Compile time error

Note: A class in which all data members are private then that class is called "bean"

Encapsulation (Continued)

"this" Keyword: Within an instance method or a constructor, this is a refrence to the current object - the object whose method or constructor is being called. You can refer to the any member of current object from within an instance method or a constructor by using this.

```
Class Student1
{   private String name;
    private int age;
    private String city;

    public Student1 (String name, int age, String city) // Constructor
    {   this.name = name;      // constructor doesn't have return type.
        this.age = age;        // Constructor called when object created
        this.city = city; }    // name is same as class name.

    public String getName()
    {   return name; }

    public int getAge()
    {   return age; }

    public String getCity()
    {   return city; }
}
```

Note: * Constructor will be there by default, if we create one, Jvm will not create the default one.

* Constructors can have parameters or can be empty, and same arguments should be passed while creating object.

```
main()
{   Student1 std = new Student1 ("Rohit", 17,
                                 "Hyderabad"); }
```

// Object created and initialized.

Constructors:

* Constructors have same name as class name
* Parameters of the Constructors are similar like method parameters.
* Constructor is called when object is created or instantiated.
* It will not ahave a return type and return statements
* Inside Constructors the first statement will be either super() or this()

  super(): calls → parent Constructor
  this(): Calls → Constructor of same class } Constructor chaining

* We can write super() / this() in first statement only.
* Constructors can be overloaded → "Constructor overloading"

Purpose: If some statement has to be executed the moment we create an object → Constructor.

this() Method: Inside one constructor if we have a requirement to call another constructor we use "this()". If the constructor we are calling through this() is not available results in error.

"this"	"this()"
* It is a keyword	It is a method
* It refers to the current object	It will call same class constructor.
method	**Constructor**
* Call explicitly by calling name	it is called when object is created
* has return type and statement	no explicit return type & stmt.

Code Snippets.

1.
```
int [][] a = {{1,2,},{3,4}};
int [] b = (int[]) a[1];
Object o1 = a;
int [][] a2 = (int[][]) o1;
System.out.(b[1]);
```
Ans : 4

2.
```
String [] x;
int [] a [] = {{1,2},{1,}};
Object c = new Long [4];
Object d = x;
```
// Compilation Succeeds.

3.
```
int x = 5;
main()
{ final Fizz f1 = new Fizz();
  Fizz f2 = new Fizz();
  Fizz f3 = FizzSwitch(f1,f2);
  System.out.(f1==f3 + " " + (f1.x == f2.x));
```
Output: true true.

```
Static Fizz FizzSwitch(Fizz x,
    Fizz y)
{ final Fizz z = x;
  z.x = 6;
  return z; }
```

4.
```
int value = 0;
boolean setting = true;
String title = "Hello";
if (value || (setting && title == "Hello")) {return 1;}
if (value == 1 & title.equals("Hello")) { return 2; }

Class A a = new Class A();
a.getValue();
```
Ans : Compilation error because value is not boolean type.

5.
```
int a=8, b=15, c=4;
System.out.(2*((a-5)*(4+(b-3)/(c+2))));
```
Output : 36

6. Sysout (23/2.0) || 11.5
Sysout (23 % 2.0) || 1.0

7. Sysout ("Hello" + 1 + 2 + 3 + 4); Output : Hello1234

8. Sysout (1 + 2 + 3 + 4 + "Hello"); Output : 10Hello

9. Sysout ("Output is :" + 10 != 5); Output : Compilation Error
On string objects only '+' operator is allowed other operators would result in compile time error.

10. Sysout ("Output is :" + (10 != 5)); Ans: Output is : true

11. int grade = 75;
if (grade > 60) Sysout ("Congo");
Sysout ("You Passed");
else
Sysout ("You failed");
Output : Compilation error because an interveen Stmt before if and else.

12. int grade = 60;
if (grade = 60)
Sysout ("you passed");
Output : Compilation Error because of assignment operator.

13. String [] arr [] = { {"%", "***"}, {"!!!", "@@@@", "####"} };
for (String str[] : arr)
{ for (String s : str)
{ Sysout (s);
if (s.length() == 4) break; }
break; }
Output : %
***

classmate
Date 14/2/23
Page

Static Keyword:

Static Variable:

* Static keyword is used before a variable
* Memory is allocated during the class loading on heap area.
* Memory is allocated once in heap
* One copy of static variables used by all the objects and memory is not allocated all the time.
* Static variables can be called using Class name.
* It is called as Class variables because one copy is shared by all the objects.
* They are object independent
* They can be accessed inside Static and Non Static elements.

Sequence of execution	Execution flow of code (default)
1. Static variables	1. Static variables → heap → during class loading
2. Static block	2. Static block → to initialise → Static variables (during class loading).
3. Static method	3. Static method → main method → Other methods (if called)
4. instance variables	
5. Non-static block	
6. Constructors	
7. methods (if called)	

Note: 1 Static variables
2 Static blocks
3 main method
} executed by default in the sequence, Other methods are need to call.

When object Created: Demo d = new Demo();
→ memory allocated for inst. variables
→ java block → constructor

eg:

```
Class Demo
{   Static int a;
    Static int b;

    Static
    {  System.out.println("Static block"); // Static block
       a=10; b=20; }

    Static void disp()
    {  System.out.println("Static method"); // Static method
       System.out.println(a);
       System.out.println(b); }

    int x, y;                    // instance variables
    {  x=10; y=20;
       System.out.println("Non Static Java Block");

    Demo()
    {  System.out.println("Constructor"); } // Constructor

    void disp1()
    {  System.out.println("Non Static method"); // method
       System.out.println(x);
       System.out.println(y); }

    void disp2()
    {  disp1(); }

    main()
    {  Demo.disp();
       Demo d= new Demo();
       d.disp(); d.disp1(); }
```

Output:

```
Static block
Static method
10 20
Non Static block
Constructor
Non Static method
10
20
```

eg

```
Class Demo2
{   Static int a;
    Static
      { a=10; }

    Static void disp()
{ System.out.println("Static disp "+a); }

}
  Public Class Launch
{
    Static void disp2()
  { System.out.println("Disp 2"); }

  Public Static void main(String[] args)
    { System.out.println("main method");
      disp2(); // directly calling (same class)
     Demo2.disp(); // calling without object creation

     Demo2 d= new Demo2();
      d.disp(); } // calling after creating object.
}
```

Output:
main method
Disp 2
Static disp 10
Static disp 10

"this()" method example:

```
Class Dog
{
  Pr. String name;
  Private int cost;

  Public Dog()
  { this("Shero", 999);
    = }

  Public Dog (String name, int cost)
  { this.name = name;
    this.cost = cost; }
    —
    —
    —
    gesture
}
```

```
main()
{ Dog d1 = new Dog();
  Dog d2 = new Dog("Robo", 10000);
```

call/invoked

calls

calls

returns

d1 → Shero 9999

d2 → Robo 10000

→ Constructors Overloaded

→ this() method calls the constructors with same parameters as the parameters passed during object creation

- Inside a constructor
  ⇓
  to call another constructor of corresponding parameters if already available
  ⇓
  this()

Constructor Chaining.

(if all are there)

Sequence of execution:

1. Static variables
2. Static block
3. Static method
4. Instance variables
5. Non Static block
6. Constructors
7. methods (if called)

Demo.java → Java C → .class file → Bytecode → Jvm

"JRE":

Jvm.
Army

Jvm → ① class loader Subsystem
② weapons
③ execution interpreter, JIT compiler...

Class loader Subsystem → loading, linking, initialization

eg: Demo d = new Demo();

Execution { ① – memory for inst. variable
② → java block → Constructor
↳ first to execute, then constructor.

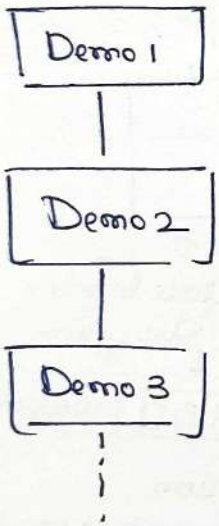
Execution flow:

1. Static variables → Heap → Class loading
2. Static block → To initialize → Stat. variables
   executed during Class loading
3. Static method – { main method (first)
   = { other methods you should call. }

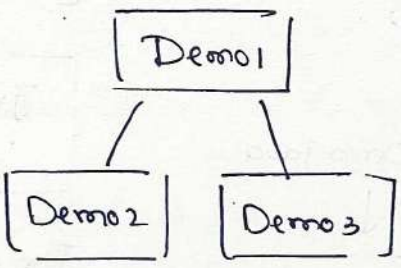
Note: ① Static variables & ② Static blocks } executed by default in the same sequence,
③ main() Other methods we need to call.

Inheritance:

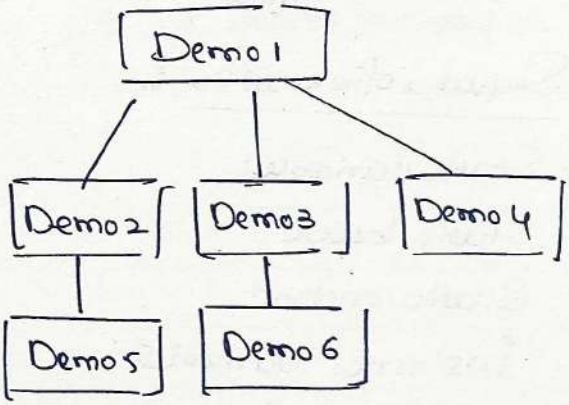
Multilevel.



Hierarchial



Hybrid



Static method	non Static method
* Static method can be called using class name (Generic)	* Object creation is mandatory for using non static methods (Specific)
* Can be called using object reference also.	* Can be called using object reference only
* Object independent, need not have to create object.	* Object dependent, need to create object for calling method.

Simple intrest Calculator Application:

```
import java.
Class farmer
{   private float pa, td, Si;
    private float Static ri;

     Static
   { ri = 2.5f; }

  public void acceptInput()
{   Scanner Scan = new Scanner(System.in);
   System.out.println("Dear, enter loan amount");
       pa = Scan.nextFloat();
   System.out.println("Dear, enter the time needed to repay");
       td = Scan.nextFloat(); }

  public void compute()
   { Si = (pa * td * ri) / 100; }

  public void disp()
   { System.out.println("Si is " + Si); }
}
```

```
public class LaunchFarmer
{
    public static void main(String[] args)
    {   Farmer f1 = new Farmer();
        Farmer f2 = new Farmer();

        f1.acceptInput(); f1.compute(); f1.disp();
        f2.acceptInput(); f2.compute(); f2.disp(); }
}
```

Q1. When to use Static variables?

Ans Whenever a common copy of data has to be shared among all the objects of a class and are not specific to any object then the data has to be used inside static

Code Snippets :

1.
```
String fruit = new String(new char[]{'m','a','n','g','o'});
switch(fruit)
{ default: Sysout("Any fruit will do");
  case "Apple": Sysout("Apple");
  case "mango": Sysout("mango");
  case "Banana": Sysout("Banana");
                 break; }
```
Output: Mango Banana

2.
```
boolean flag = true;
Sysout(!flag ? args[0] : args[1]);
```
Args: Am Pm.
Output: Am.

3.
```
int a = 3;
Sysout(a++ == 3 || --a == 3 && --a == 3); // true
Sysout(a); // 4
```

4. int a = 3;
m(++a, a++);
Sysout(a);

static void m(int i, int j)
{ i++; j--; }

Output : 5.

5. boolean flag = false;
Sysout((flag = true) | (flag = false) || (flag = true));
Sysout(flag); Output : true true
false

6. boolean status = true;
Sysout(status = false || status = true | status = false);
Sysout(status); Ans : Compilation error (because of assign operator)

7. String msg = "Hello";
boolean [] flag = new boolean [1];
if(flag[0]) msg = "Welcome";
Sysout(msg); Output : Hello.

8. boolean flag1 = true, flag2 = false, flag3 = true; flag4 = false;
Sysout(!flag1 == flag2 != flag3 == !flag4); // false
Sysout(flag1 = flag2 != flag3 == !flag4); // true.

9. int Score = 30; Char grade = 'F';
if(50 <= Score < 60) grade = 'D'; // Compilation error
- nesting of relational operator is not possible.

Inheritance in Java

Code example

```
Class Demo1
{   String name = "Hyder";
    int age = 28;

    void disp()
    { System.out.println("Demo1" + age);
    }

Class Demo2 extends Demo1
{                          }

Public Class Launch1
{   public static void main (String [] args)
    {   Demo2 demo = new Demo2();
        demo.disp(); }
}
```

Output:

Demo1 28
(because of inheritance)

Demo 2 is child/derived
Demo 1 is parent/base
and it extends "Object-class".

Relationship

- (Inherit-anc) **is-A**
- **has-A** { Dependencies injection, Aggregation & composition.

Also called:

1. Parent-child relationship
2. base class - Sub class
3. existing class - derived class.

Unrelated classes → we developed relation (code reusability)
→ through "extend" keyword.

Inheritance Key points:

* Inheritance is a relationship
* Single inheritance is allowed (one class can extend another class).
* Object class is parent of all class.
* Multilevel inheritance is allowed.
* One parent/base class can have any no. of child/subclass. (Hierarchial inheritance allowed).
* Hybrid inheritance (Hierarchial + multilevel) allowed.
* Multiple inheritance is not allowed (one class can have only one parent).
* Cyclic inheritance is not allowed.
* Private members will not participate in inheritance because to preserve the property of encapsulation.
* Constructor will not participate in inheritance however parent class constructor will be called because of "super()" method call present inside the child class

eg:

```
Class Parent
{ private String name;
  Parent()
  { System.out.println("Parent Constructor"); }

  void disp()
  { System.out.println("Parent"); }
}

Class Child
{ // Child()
  // { // super(); }
  void disp2()
  { //name = hyder; }
}
```

↳ private member Can't access.

```
main()
{ Child c = new Child();
  c.disp(); }
```

Output: Parent Constructor
Parent

eg

```
Class Parent
{ int a, b;
  Parent() // constructor
  { a=10;
    b=20;
    Sysout("Parent Const"); }

  Parent(int a, int b) // Para const.
  { this.a=a;
    this.b=b;
    Sysout("Parent para Const"); }
  }

main()
{ Child ch = new Child();
  ch.disp(); }
```

```
Class Child extends Parent.
{ int x, y;
  Child() // Constructor
  { Super(); // adding this will call parent class Const.
    x=100;
    y=200; }

  Child(int x, int y) // param. Constr.
  { this.x = x;
    this.y = y; }

  void disp()
  { Sysout(a); Sysout(b);
    Sysout(x); Sysout(y); }
  }
```

Output: Parent Const
10 20 100 200

Another variation:

```
Child(int x, int y)
{ Super(x, y); // adding parameters to Super will call the parametrized parent constructor
  this.x=x;
  this.y=y; } // atleast one constructor (in child class) must have Super method else not allowed.

main()
{ Child ch = new Child(1000, 2000);
  ch.disp(); }
```

Output: Parent para const
1000 2000 1000 2000

Access Specifiers : access specifiers help to restrict the scope of a class, constructor, variable, method, or data member

There are four access specifiers:

1. Public
2. protected
3. default
4. private (strongest)

(visibility) ↑

eg

default ↑

void display()
{
}

	Within a class	Outside class within package	Outside package (is-A relationship)	Outside package (no is-A relation)
public	✓	✓	✓	✓
protected	✓	✓	✓	×
default	✓	✓	×	×
private.	✓	×	×	×

eg code

```
Class Plane
{ public void takeOff()
  { Sysout("Plane taking off"); }

public void fly()
  { Sysout("plane is flying"); }

public void landing()
{ Sysout("plane is landing"); }
}

Class CargoPlane extends Plane
{
  public void fly()
{ Sysout("Cargo plane fires"); }

  Public void CarryGoods()
{ Sysout("Carries goods"); }
}

Class PassengerPlane extends Plane
{
  public void fly()
{ Sysout("Passenger plane fies"); }

  Public void CarryPassengers()
{ Sysout("Passenger plane
      carries passengers"); }
}
```

```
main (String [] args)
{
    CargoPlane cp = new CargoPlane();
    PassengerPlane pp = new PassengerPlane();

    cp.takeOff(); // inherited method
    cp.carryGoods(); // Specialised method
    cp.fly(); // overridden method
    cp.landing(); // inherited method

    pp.takeOff();
    pp.carryPassengers();
    pp.fly();
    pp.landing(); }
```

Output:

```
Plane is taking off.
Cargo plane carries goods
cargo plane flies
Plane is landing

Plane is taking off
Passenger plane carries
    passengers
Passenger plane flies
plane is landing
```

Rules to override methods:

1. We cannot reduce the visibility of overridden method but we can increase it.
2. Return type of the overridden method must be same as that of overriding method in parent.
3. Return type of overridden method in child class can be different than that of parent class if it is co-variant return type (return type: is-A relationship)
4. Parameters of overridden methods must be same as that of parent else it will be considered as specialized method considering method overloading concept.

"Super()" method: * Super method will be there inside constructor.
* it will call the parent class.

Super Keyword : Super keyword is used in child class to get the values of parent class.

eg:
```
Class Demo1
{ int age = 28; }

Class Demo2 extends Demo1
{ int age = 27;

  void disp()
  { System.out.println(age); // 27
    System.out.println(super.age); // 28 (parent class value)
  }
}
```

final Keyword : the final keyword is a non access modifier used for classes, variables and methods which makes them non changeable.

* final variables acts as constants we cannot change the value.
* Classes declared as final don't participate in inheritance.
* Methods declared as final can be inherited but cannot be overridden.

Code Snippets

1.
```
Class Counter
{ int count;
  private static void inc(Counter counter)
  { counter.count++; }

Counter c1 = new Counter();
Counter c2 = c1;
Counter c3 = null; c2.count = 1000;
inc(c2); }
```

Ans: No. of objects created: 1

2.
```
String res = "";
loop: for (int i=1; i<=5; i++)
{  switch (i)
   {  case 1 : res += "UP"; break;
      case 2 : res += "TO"; break;
      case 3 : break;
      case 4 : res += "DATE"; break loop; }
}
   System.out (res); // UP TO DATE
   System.out (String.join ("-", res.split (" "))); // UP-TO-DATE
```

3.
```
String res = "";
String [] arr = {"Dog", null, "Friendly"};
for (String s: arr)
   { res += String.join ("-", s); }
System.out (res); // Dog-null-Friendly.
```

4.
```
String [][] chs = new String[2][];
 chs[0] = new String [2];
 chs [1] = new String [5];  int i=97;
for (int a=0; a<chs.length; a++)
 { for (int b=0; b<chs.length; b++)
    { chs [a][b] = "" + i;  i++; }
 }
for (String [] ca : chs)
 { for (String c: ca)
    { System.out (c + " "); }
   System.out.println(); }
```

Output: 97 98
99 100 null null null

5.
```
String ta = "A";
ta = ta.concat ("B");
String tb = "C";
ta = ta.concat (tb);
ta.replace ('C', 'D');
ta = ta.concat (tb);
System.out (ta);
```

Out: A B C C

6. StringBuilder sb = new StringBuilder ("B");
sb.append (sb.append ("A"));
Sysout (sb); Output : BABA.

7.
```
Class A
{ public String toString()
  { return null; }
}
```

```
main()
{ String text = null;
  text = text + new A();
  Sysout (text.null); }
```

Output : (null null)
8.

8.
```
Class SpecialString
{ String str;
  SpecialString (String str)
  { this.str = str; }
}

main()
{ Object[] arr = new Object[4];
```
(Continued next).

```
for (int i=1; i<=3; i++)
{ switch (i):
  { Case 1 : arr[i] = new String ("Java");
             break;
    Case 2 : arr[i] = new StringB("Java");
             break;
    Case 3 : arr[i] = new SpecialString
             ("Java"); break;}
}
  for (Object obj : arr)
  { Sysout (obj); }
}
```

Output : null
Java
Java
SpecialString @ hashcode

9.
```
Class MyStringClass extends String
{ String name; }
```
Output : Compile time error.

10. String name = "sachintendulkar".substring(4); // intendulkar.

11. String s = "1".repeat(5);
Sysout (s); // 11111

12. Sysout ("1".concat("2").repeat(5).charAt(7)); // 2.

13. To which of following classes, you can create object without 'new'?
   a. String
   b. StringBuilder
   c. StringBuffer

14. String String = "String".replace('i', 'O');
   Sysout (String.substring(2,5);); Output: rOn.

15. Sysout ("Java" == new String("Java")); // False

16. if ("string".toUpperCase() == "STRING")
      Sysout (true);
   else
      Sysout (false);
   Output: false.

17. String, StringBuffer and StringBuilder - all final classes?
   Ans: Yes

18. String str1 = "1", str2 = "22", str3 = "333";
   Sysout (str1.concat(str2).concat(str3).repeat(3));
   Output: 122333122333122333

19. Sysout ("Java" + 1000 + 2000); Output: Java 1000 2000

20. Sysout (1000 + 2000 + "Java"); Output: 3000Java

21. Sysout (7.7 + 3.3 + "Java" + 3.3); Output: 11.0 Java 3.3.

22. String s1 = " "; Sysout (s1.isBlank();); // true (one blank space avai
   Sysout (s1.isEmpty();); // false

```
Class Parent
{
  Public Static void disp()
  { Syso ("Hello parent"); }
}

Class Child {
  Public Static void disp()
  { Syso ("Hello Child"); }
}
```

* Static methods participate in inheritance.
* If you override Static methods, it will be treated as Specialized methods

```
Pgm.
  main()
  {
    Parent p = new Child();
    p.disp(); // Hello parent, because child class disp() is a Specialized function so you get parent class method

    Child c1 = new Child();
    c1.disp(); // Hello Child, because it is Specialized method
  }
```

Polymorphism in Java

```
Class Parents
{ public void cry()
  { Sysout ("Parents Crying"); }

//public void eat()
{ Sysout ("Parents eating"); }
}//
```

assume this is not there

```
Class Child1 extends Parents
{ public void cry()
  { Sysout ("Child1 crying"); }

  public void eat()
  { Sysout ("Child1 eats less"); }
}
```

Output: Child 1 crying
Child 1 eats less
Child 2 crying
Child 2 eats more

```
Class Child2 extends Parents
{ Public void cry()
  { Sysout ("Child Crying"); }

  public void eat()
  { Sysout ("Child2 eats more"); }
}
```

```
main()                    (valid)
{ Parents p = new Child1();
  p.cry(); // "Child1 crying"
//p.eat(); // directly using parent type you cannot call child class Specialized methods
((Child1)p).eat(); // Child1 eating
                   // downcasting
Parents p2 = new Child2();
  p2.cry(); // Child 2 crying
((Child2)p2).eat(); }
                   // Child 2 eats more.
```

Polymorphism:

Polymorphism in java is a concept that allows objects of different classes to be treated as common class. It enables objects to behave differently based on their specific class type.

Advantages: * Increases code reusability by allowing objects of different classes to be treated as objects of common class.

* Enables objects to be treated as a single type, making it easier to write generic code that can handle objects of different types.
* Improves readability and maintainability of the code.

Upcasting: Upcasting is the typecasting of a child object to a parent object.

Downcasting: downcasting means the typecasting of a parent object to a child object.

eg: Parent p = new Child();
((Child) p).eat();
(downcasting (Calling Specialized method

eg2

```
Class Plane
{ public void takeOff()
  { Sysout("Plane taking off"); }

  public void fly()
  { Sysout("Plane is flying"); }

  public void landing()
  { Sysout("Plane Landing"); }
}

Class CargoPlane extends Plane
{ public void fly()
  { Sysout("Cargo Plane flies"); }
}

Class PassengerPlane ext. Plane
{ public void fly()
  { Sysout("Passenger Plane
        flies"); }
}

Class FighterPlane extends Plane
{ public void fly()
  { Sysout("Fighter plane flies"); }
}

Class Airport
{ public void permit // takes
      (Plane plane)  plane
  { plane.takeOff();  cargo and
    plane.landing();  does all
    plane.fly(); }    work
}

main()
{ CargoPlane cp = new CargoPlane();
  FighterPlane fp = new FighterPlane();
PassengerPlane pp = new Pass.Plane();
  Airport a = new Airport();
a.permit(cp);
a.permit(fp);
a.permit(pp); }
```

Abstraction in Java:

Abstraction is a process of hiding the implementation details and showing only functionality to the user.

Abstract Keyword:

→ Abstract keyword cannot be applied to a variable

→ Abstract keyword can be applied to a method and the method should not have a body.

→ Abstract keyword is added to a class when there is atleast one abstract method.

eg

```
abstract class Loan
{   abstract public void dispInt();
        public void WelcomeNote()
    {   System.out.println("Welcome to xyz Bank"); }
}

Class HomeLoan extends Loan
{   Public void dispInt()
    {   System.out.println("RI is 12:1"); }
}

Class EducationLoan extends Loan
{   public void dispInt()
    {   System.out.println("RI is 10:1"); }
}

main()
{   // Loan l = new Loan(); // we Cannot Create Object of
                            Abstract Class.
```

```
Loan l1 = new HomeLoan(); // we can create reference of
                            abstract class.
l1.dispInt(); // RI is 12%.
l1.welcomeInt(); // Welcome to xyz Bank
Loan l2 = new EducationLoan();
l2.dispInt(); // RI is 10%.
l2.welcomeNote(); // Welcome to xyz Bank
}
```

Abstract Key points:

* We Cannot Create abstract class object.
* Abstract Class can have all methods abstract. (100% abstraction).
* Abstract Class can have both abstract and concrete methods.
* Abstract Class can have all methods Concrete.
* The subclass / child class if extending abstract class then either have to implement abstract method (or) declare class abstract.
* Constructor Cannot be made abstract.
* abstract → incomplete class
  → child class will implement } inheritance
* We Cannot make abstract class as final, doing such is illegal.
* We Cannot make abstract method as final → illegal.
* Variable Cannot be made abstract.
* We can have Constructor in abstract class.

Area Calculator Program

```
import java.util.Scanner;
abstract class Shapes
{   float area;
    abstract public void input();
    abstract public void Compute();
```

```
    public void disp()
     { System.out.length ("-the area is " + area);
}

Class Rectangle extends Shapes
{  float length, breadth;
    public void input()
    {   Scanner Scan = & new Scanner (System.in);
        System.out.println ("Enter length of rectangle");
            length = Scan.nextInt();
        System.out.println ("Enter breadth of rectangle");
            breadth = Scan.nextFloat(); }

    public void Compute()
    {   area = length * breadth ; }
}

Class Square extends Shapes
{   float length;
    public void input()
    {   Scanner Scan = new Scanner (System.in);
        System.out.println ("Enter length of square");
         length = Scan.nextFloat(); }

    public void Compute()
    {  area = length * length; }
}

Class Circle extends Shapes
{    float radius;
    final float pi = 3.14f;
```

```
    public void input()
  { Scanner scan = new Scanner (System.in);
    System.out.println ("Enter radius of circle");
    radius = scan.nextFloat(); }

    public void compute()
  { area = pi * radius * radius; }
}

Class Geometry
{   void permit (Shapes s)
    { s.input();
      s.compute();
      s.disp(); }
}

public Class LaunchProject
{
   public static void main (String[] args)
{
    Rectangle r = new Rectangle();
    Square ss = new Square();
    Circle c = new Circle();

    Geometry g = new Geometry();
     g.permit (r);
     g.permit (ss);
     g.permit (c); }
}
```

Code Snippets

1.
```
for (int i=5; i>=1; i--)
{ Sysout ("*".repeat(i)); }
```

```
* * * * *
* * * *
* * *
* *
*
```

2
```
boolean opt = true;
Switch (opt)
{ Case true: Sysout ("True"); break;
  default: Sysout ("****"); }
Sysout ("Done");
```

What modifications should be enabled to print "True Done"?
: Replace first line with String s="True", Case with "True";

3.
```
StringBuilder Sb = new StringBuilder(5);
String s="";
if (Sb.equals(s)){ Sysout ("match1"); }
else if (Sb.toString().equals (s.toString())) {Sysout ("match 2"); }
else Sysout ("match 3");
```
Output: match 2

4.
```
String text ="RISE";
text = text + (text ="ABOVE");
Sysout (text);
```
Output: RISE ABOVE

5.
```
StringBuilder Sb = new StringBuilder ("Java");
String S1 = Sb.toString();
String S2 = "Java";
Sysout (S1==S2);
```
Output: False

6
```
StringBuilder Sb = new StringBuilder ("Java");
String S1 = Sb.toString();
String S2 = Sb.toString();
Sysout (S1==S2);
```
Output: False

7. String str = "Java";
StringBuilder sb = new StringBuilder("Java");
Sysout(str.equals(sb) + ":" + sb.equals(str));
Output: false false

8. StringBuilder sb = new StringBuilder();
Sysout(sb.append(null).length()); Compilation Error

9. StringBuilder sb = new StringBuilder(5);
sb.append("0123456789");
sb.delete(8,1000); Sysout(sb); Output: 01234567

10. StringBuilder sb = new StringBuilder("Hurrah!")
sb.delete(0,1000); Sysout(sb); Output: 0

Dependency Injection:

The process of injecting dependant object into target object is caued as "Dependency Injection".

We can achieve dependency injection in 2 ways
(a) Constructor dependency injection
(b) Setter dependency injection

Constructor dependency injection: Injecting dependant object into targest through a constructor.

Setter dependency injection: injecting dependent object into target object through a Setter.

eg

```
Class Address // Dependency Object
{          }

Class Student // Target Object
{     // HAS-A relationship
      Address address; }
}
```

Relationships in Java

As part of java application development, we have to use entities as per application requirements. In java application development, if we want to provide optimizations over memory utilization, code reusability, execution time, Sharability then we have to define relationships between entities.

There are three types of relationships between entities

1. HAS-A relationship (extensively used in projects)
2. IS-A relationship
3. USE-A relationship

Difference between HAS-A and IS-A relationship:
HAS-A relationship will define associations between entities in java applications, here associations between entities will improve Communication between entities and data navigation between entities.

IS-A relationship is able to define inheritance between entity classes, it will improve "Code Reusability" in java applications.

Associations in Java

1. One to One Association (1:1)
2. One to many association (1:m)
3. Many to one association (m:1)
4. Many to many association (m:m)

To achieve associations between entities, we have to declare either single reference or array of reference variables of an entity class in another entity class.

eg

```
Class Address{
.....
}
```

```
Class Account{
.....
}
```

```
Class Employee{
.....
    Address [] addr; // it will establish 1:m association
    Account account; // 1:1 association
}
```

1. **One to one association**: it is a relationship between entities, where one instance of an entity should be mapped with exactly one instance of another entity.
   eg: Every employee should have only one account

Account.java:

```
package in.ineuron.bean;
// Dependent object
```

```
public class Account
{   String accNo;
    String accName;
    String accType;

    Public Account (String accNo, String AccName, String accType)
{   super();
    this.accNo = accNo;
    this.accName = accName;
    this.accType = accType; }
}
```

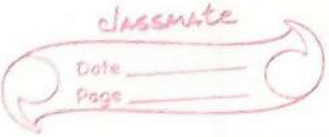
Employee.java:

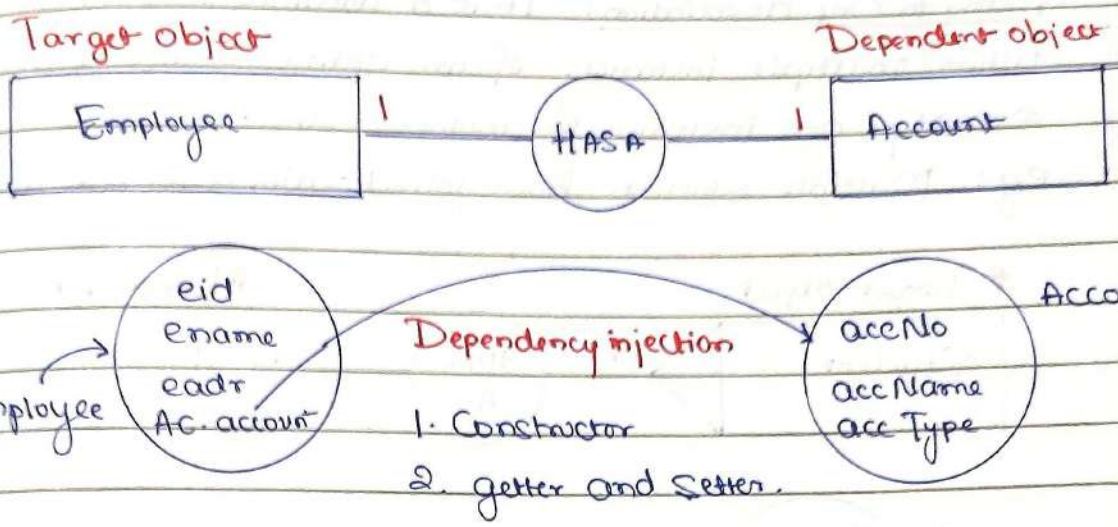
```
                Package.in.ineuron.bean;
                                    // Target object
Pubsrc Class Employee
{   Private String eid;
    Private String ename;
    Private String eadr;

    Account account; // HAS-A relationship

  public Employee (String eid, String ename, String eadr,
                                    Account account) // Constructor injection
{   Super();
    this.eid = eid;
    this.ename = ename;
    this.eadr = eadr;
    this.account = account; }
```

```
Public void getEmployeeDetails()
{  Sysout ("Employee details are:");
   Sysout ("Empid :" + eid);
   Sysout ("Empname:" + ename);
   Sysout ("Emp address :" + eadr);
     System.out.println();
   Sysout ("Account details are");
   Sysout ("Account no:" + account.accNo);
   Sysout ("Account name:" + account.accName);
   Sysout ("Account type:" + account.accType); }
}
```

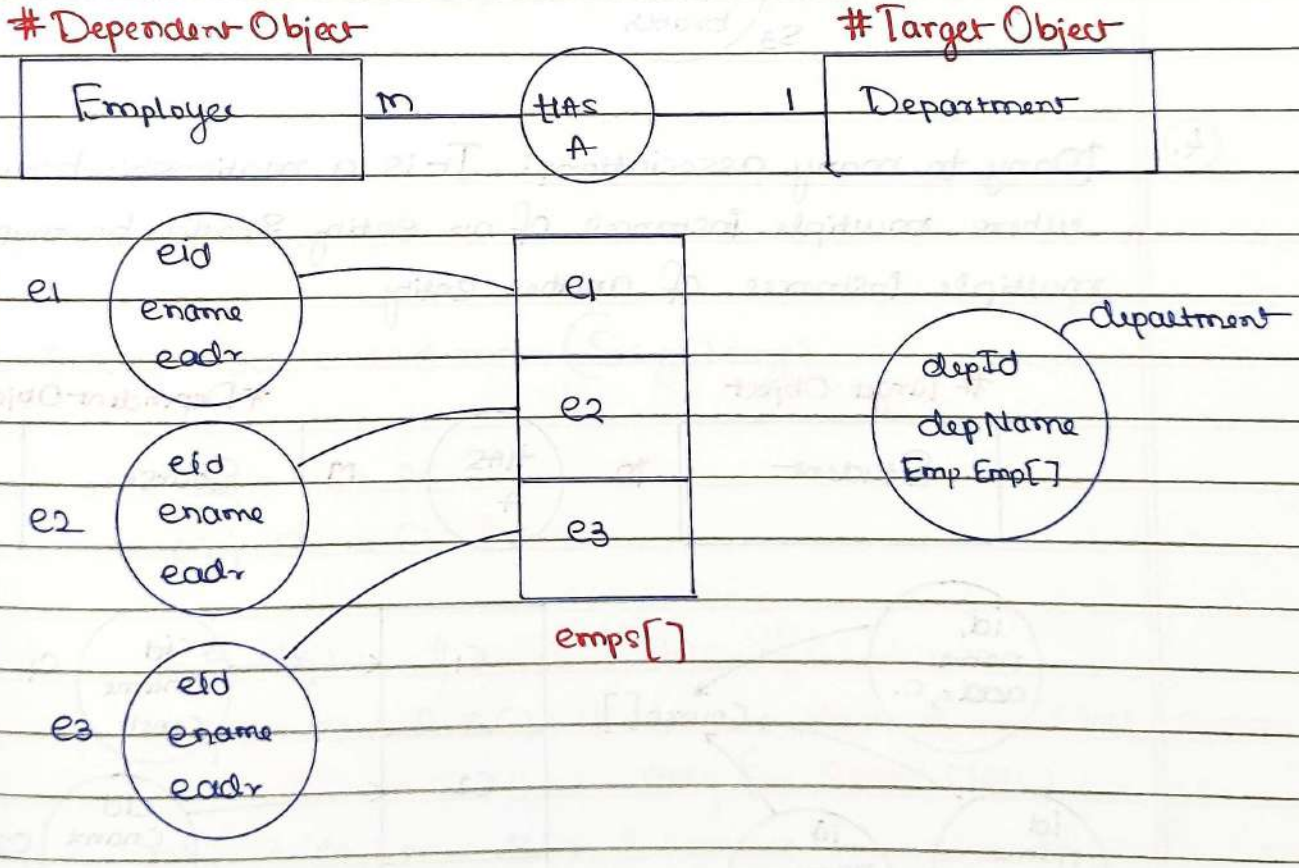
TestApp.java :

```
package.in.ineuron.main;
import.in.ineuron.bean.Account;
import.in.ineuron.bean.Employee;

Public Class TestApp{
   public static void main(String[] args)
{
   Account account = new Account("ABC123", "Sachin", "Savings");

   // Constructor injection
Employee employee = new Employee("IND10", "Sachin", "MI",
                                  account);
   employee.getEmployeeDetails(); }

}
```

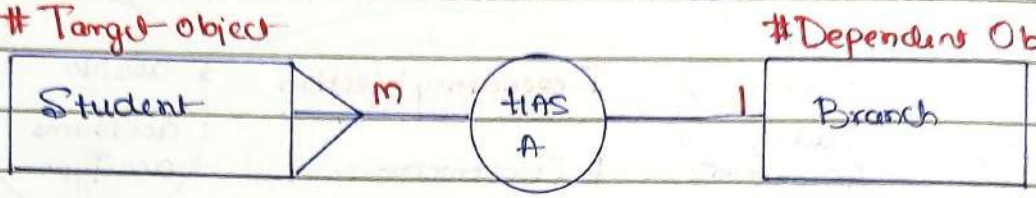


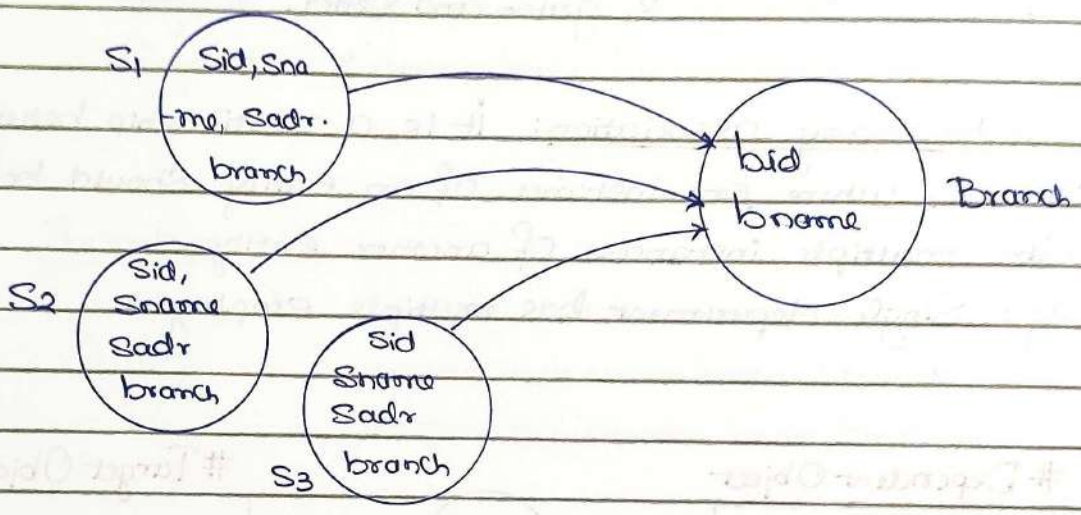


(2) One to many association: it is a relationship between entity classes, where one instance of an entity should be mapped with multiple instances of another entity.
eg: Single department has multiple employees

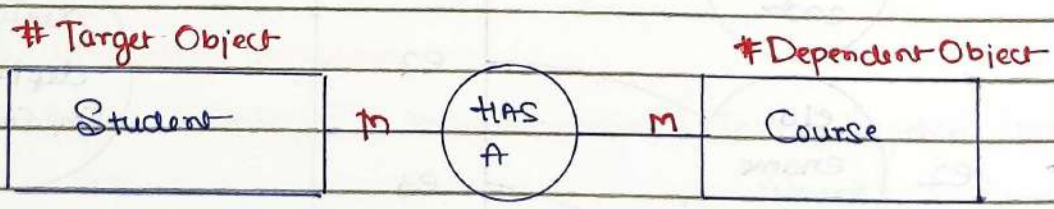


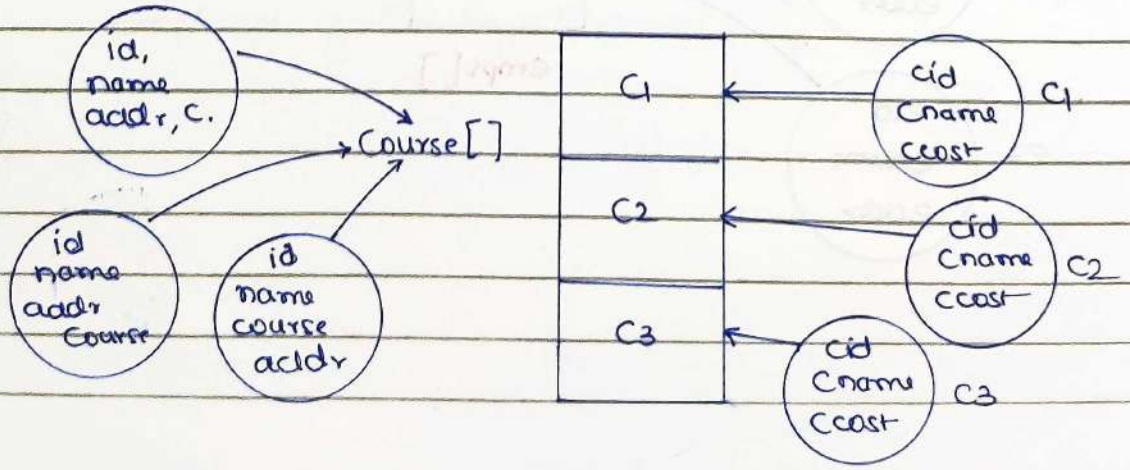
(3.) Many to One association: It is a relationship between entities, where multiple instances of an entity should be mapped with exactly one instance of another entity.
eg: Multiple Students have joined with a single branch.





(4.) Many to many associations: It is a relationship between entities, where multiple instances of an entity should be mapped with multiple instances of another entity.





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Inner Class in Java

In java you can define a class within another class. Such a class is called nested class/inner class. Inner classes are divided into two categories : static and non-static. Nested classes that are declared static nested are called static inner class and only inner class can be declared static.

Code:

```
Class A
{   Public void Show()
    { System.out.println("in Show"); }

   Class B                    // inner class
   {                          // object of inner class can be created in A.
      Public void Config()
        { System.out.println("in Config"); }
   }
}

public class FirstCode
{
  Public Static void main(String[] args)
  {
      A obj = new A();
        obj.Show(); // in Show

      A.B obj1;  // Creating object of inner class
      obj1 = new A.B(); // Creating object of inner class (Syntax
                           only for Static class)
      obj1 = Obj.new B(); // Creating inner class object from A obj
      obj1.Config(); } // in Config
}
```

Code 2:

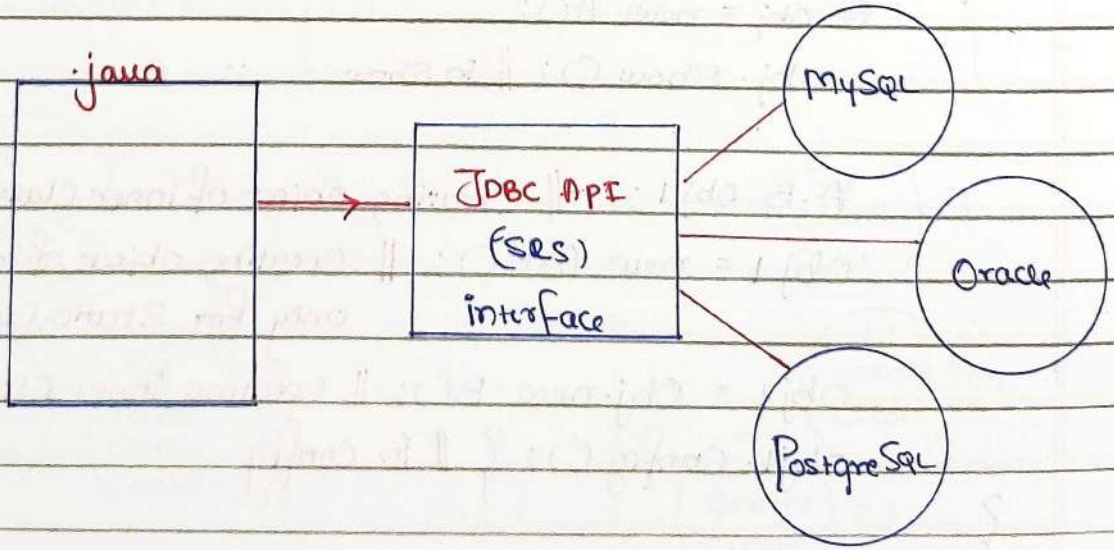
```
Class Computer
{
    public void config()
    { System.out.println ("in Computer config"); }
}

public class SecondCode
{
    public static void main (String[] args)
    {
        Computer obj = new Computer()
        { public void config()  // Overriding Computer method
            { System.out.println ("Something new"); }
        };
        obj.config(); // Something new.
    }
```

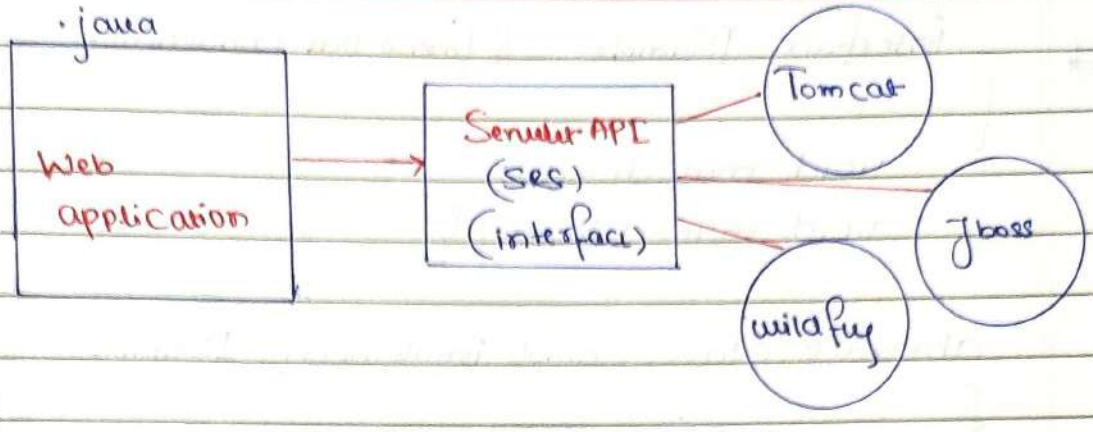
inner class

Note: There three classes are available and three .class files are generated.

Interface in Java

Def 1: Any service requirement specification (SRS) is called interface.





Note:

* Inside interface every method is always abstract weather we are declaring or not, hence interface is considered as 100% pure abstract class.

eg: interface Account

```
{
    // 100% abstract class,
    // methods are abstract and public by default
    void withdraw();
    void deposit(); }
```

Summary: Interface corresponds to Service requirement Specification or Contract b/w client and Service provider or 100% abstract class.

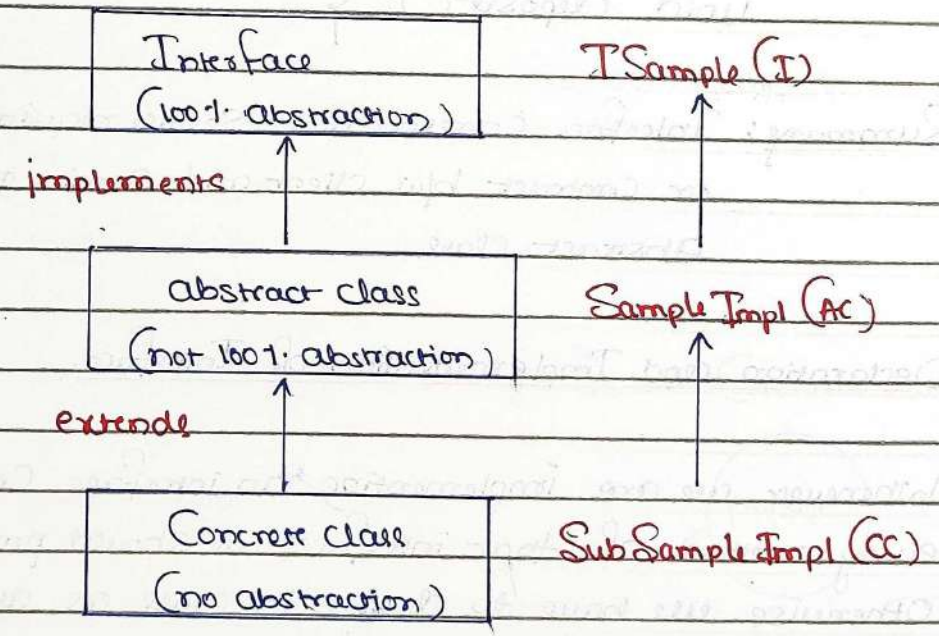
Declaration and Implementation of Interface.

1. Whenever we are implementing an interface compulsorily for every method of that interface we should provide implementation Otherwise we have to declare the class as abstract class in that case child class is responsible to provide implementation for remaining methods.

2. While implementing an interface method, it should be declared public Otherwise results in Compile Time Error.

eg

```
interface ISample   // follow this convention
{
    void methodOne();
    void methodTwo();}

abstract class Sample implements ISample
{
    public void methodOne()  // method1 defined, but 2nd not defined
    { . . . . . }            // So class is abstract.
}

Class SubServiceProvider extends Sample
{   @Override //indication to Compiler (methods are overridden)
    public void methodTwo(){...} //method 2 defined
}
```



SampleImpl ref = new SubSampleImple(); not good approach

ISample ref = new SubSampleImpl(); good approach

Code Snippets

1. String Str = " ";
   Sysout (Str.isBlank()); // true
   Sysout (Str.isEmpty()); // false

2 Which classes of "Strings" have reverse() and reverse() method?
Ans StringBuilder and StringBuffer.

3 java.lang.String class has append() method? Ans: No

4
```
String Str1 = "Java";
String Str2 = Str1.intern();
String Str3 = new String ("Java");
Sysout (Str1 == Str2) // true
Sysout (Str2 == Str3); // false
Sysout (Str3 == Str1); // false
```

5
```
String Str1 = "Java";
String Str2 = Str1.intern();
(Str1 == Str2); // true
Sysout (Str1.equals (Str2); // true
```

6
```
StringBuffer Sb1 = new StringBuffer ("11111");
StringBuffer Sb2 = Sb1.append (22222).append.reverse();
Sysout (Sb1 == Sb2); // false
```

7. StringBuilder and StringBuffer class have 'intern()' method? No

8. Sysout (String.join (",", "1", "2", "3").concat (",").repeat (3).lastIndexOf (","));
   17

9. StringBuffer sb = new StringBuffer ("11111");
   Sysout (sb.insert (3, false).insert (5, 3.3).insert (7, "one"));
   Output: 111fa3.One3.3ell.

Interfaces (continued)

Difference between extends and implements

extends : One class can extend only class at a time

```
eg: class One { }
    class Two extends One { }
```

implements : One class can implements any number of interface at a time.

eg: Case 1

```
interface IOne
{ public void methodOne(); }

interface ITwo
{ public void methodTwo(); }

Class Demo implements IOne, ITwo
{ public void methodOne() { };
  public void methodTwo() { }; }
```

Case 2 : Class can extend as well as can implement an interface

1. reusability : → extends
2. interface : → implementation

```
Class Sample
{ public void m1(){} }

interface IDemo
{ void m2(); }

Class DemoImpl extends Sample implements IDemo
{ public void m2(){} }
```

Case 3 : An interface can extend any no. of interfaces at a time.

eg:

```
interface One
{ public void m1(); }

interface Two
{ public void m2(); }

interface Three extends One, Two
{ public void m1();
  public void m2();
  public void m3(); }
```

Q1. Which of the following is true?

a. A class can extend any no. of class at a time.

b. An interface can extend only one interface at a time

c. A class can implement only one " " "

d. A class can extend a class and implement an interface but not simultaneously.

e. An interface can implements any no of interfaces at a time

f. none of the above.

Q2. Consider the expression X extends Y which of the possibility of X and Y expression is true?

1. Both x and y should be classes
2. " " " interfaces
3. " " can be classes or interfaces
4. No restriction

Interface Methode:

Every method present inside the interface is public and Abstract.

Valid declarations are:

1. void m1();
2. public void m1();
3. abstract void m1();
4. public abstract void m1();

WHY?

Public :→ to make the method available for every implementation class.

Abstract :→ implementation class is responsible for providing the implementation.

eg: JDBC API (java.sql.*)

Implementation given by :→ mySQL, Oracle, Postgre

* Methods allowed in interface is : public, abstract (2)
  we can't use : Static, Private, protected, Strictfp, Synchronized, native, final.

Interface Variables:

* Inside the interface we can define variables.

* Inside the interface variables define requirement level constants.
* Every variable inside interface is "public static final" by default.

WHY?

public :→ to make it avail. for implementation class object
static :→ to access it without using implementation class name.
final :→ implementation class can access value without any modification.

Note: * Since variables defined inside interface is public, static and final we cannot use modifiers like private, protected, transient, volatile.

* Since the variable is static and final, compulsorily it should be initialized at the time of compilation / declaration. Otherwise results in CE.

Interface Naming Conflicts

Case 1: if two interfaces contain a method with same signature and same return type in the implementation class only one method implementation is enough.

eg:

```
interface Left{ public void m1(); }
interface Right{ public void m1(); }

Class Test implements Left, Right{
    @Override
    public void m1(){...}
}
```

Case 2: if two interfaces contain a method with same name but different arguments in the implementation class we have to provide implementation for both methods and these methods acts as overload methods.

eg:

```
interface Left{ public void m1(); }
interface Right{ public void m1(int i); }
Class Test implements Left, Right
{   @Override
    public void m1(){...}
    public void m1(int i){...} }
```

Q1 Can a java class implements two interfaces simultaneously?

Ans. Yes, possible but in both the interfaces method signature should be same, but not different return types

Case 3 : If two interfaces contain a method with same signature but different return types then it is not possible to implement both interface simultaously.

eg:

```
interface Left { public void m1(); }
interface Right { public int m1(); }
class Test implements Left, Right {
    @Override
    public void m1() { ... }
    @Override
    public int m1() { ... }  // Invalid, So can't implement both simultaneously.
}
```

Q2 Can java class implements two interfaces simultaneously?

Ans Yes possible, except if two interfaces contain a method with same signature but different return types.

Variable Naming Conflicts :

Two interfaces can contain a variable with same name and there may be a chance of variable naming conflicts but we can resolve variable naming conflict by using interface names.

eg:

```
interface Left { int x=10; }
interface Right { int x=20; }
public class Test implements Left, Right {
    public static void main (String [] args)
    { System.out.println (Left.x); System.out.println (Right.x); } }
```

Output: 10 20

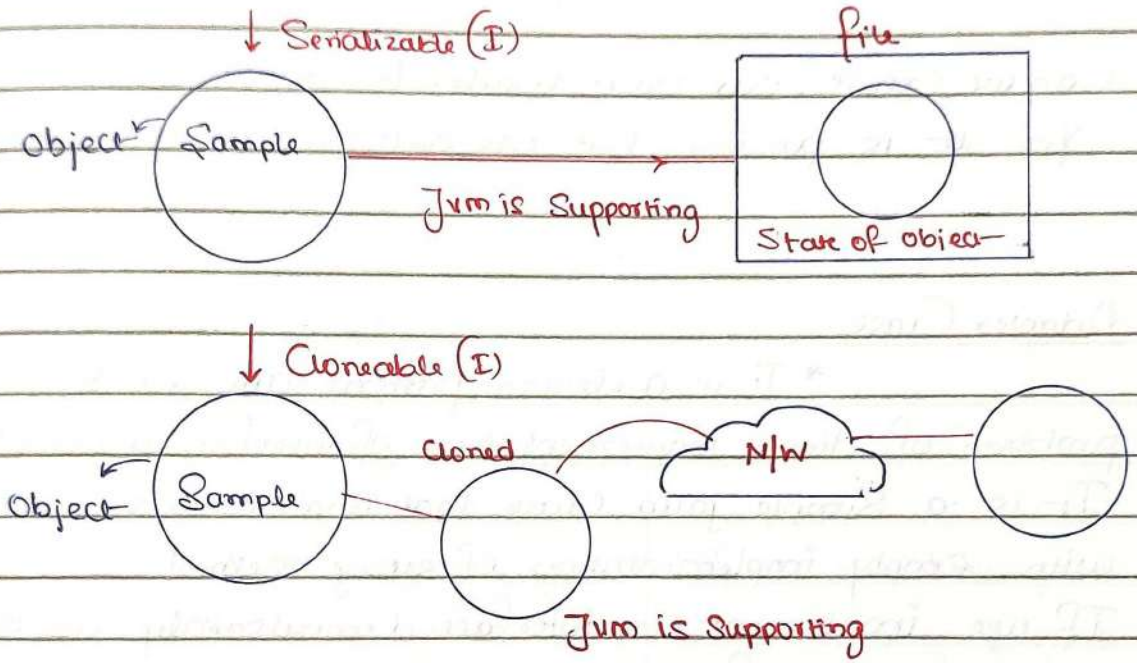
Note: We can also write an interface without any variable or abstract methods.

eg * interface Serializable { }

Class Sample implements Serializable { ... }

* interface Cloneable { }

Class Sample implements Cloneable { ... }



Marker Interface:

If an interface does not contain any method and by implementing that interface if our Object will get some ability Such type of interface are called "Marker Interface" / "Tag Interface" / "Ability Interface".

eg:

1. Serializable: by implementing Serializable interface we can send that object across the network and we can save state of an object into the file
2. Single Thread Model: by implementing it interface Servlet can process only one client request at a time so we can get "Thread Safety".

3. Cloneable : by implementing it our object is in a position to provide exactly duplicated clone object.

Q3 Without any methods in marker interface how objects will get ability?

Ans Jvm is responsible to provide required ability.

Q4 Why Jvm is providing the required ability?

Ans To reduce the complexity of programming.

Q5 Can we create our own marker interface?

Ans Yes, it is possible but we need to customize Jvm.

Adapter Class :

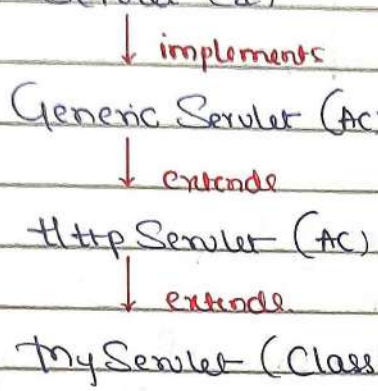
* It is a design pattern allowed to solve the problem of direct implementation of interface methods.
* It is a simple java class that implements an interface only with empty implementation of every method.
* If we implement an interface compulsorily we should give the body for all the methods weather it is required or not. This approach increases length of code and reduces readability.

eg: interface X
{ void m1();
void m2();
void m3(); }

abstract class Samp Adapter X implements X
{ public void m1(){ } // giving dummy implementation
public void m2(){ }

```
    public void m3(){ }
}
Class Test extends AdapterX
{   public void m3()  // giving implementation only for required
    { System.out.print("I am from m3"); }   methods.
}
```

eg:



	Interface	Abstract Class
*	If we don't know anything abt implementation and just have requirement specification, we should go for interface.	If we are talking about implementation but not completely then we should go for abstract class.
*	Every method present inside the interface is always public and abstract (default).	Every method present inside abstract class need not to be public and abstract.
*	We can't declare methods as private, protected, final, static, synchronized, native, strictfp.	No restriction on abstract class method modifiers.
*	Every variable : public, static, final.	Need not to be public static final.

*	Cant declare variables as private, protected, transient, volatile.	No restriction on access modifiers.
*	Every variable should be initialized at time of declaration.	No need to initialize variables at time of declaration.
*	We can't write static and instance block	Static and instance blocks allowed
*	Can't write constructor	We can write constructor.

Note:

Static block : • class file loading happens and used to initialize static variables.

instance block : during the creation of an object, just before the constructor call used for initialization of instance variables.

Constructor : during the creation of an object, used for initialization of instance variables.

Q6 What is the need of abstract class? Can we create an object class and does it contains constructor?

Ans Abstract class object cannot be created because it is abstract. But constructor is needed for constructor to initialize the object.

Q7 Why abstract class can contain constructor whereas interface cannot?

Abstract class : * it is used to perform initialization of object
* to provide value for the instance variable
* to contain instance variable which are req for child object to perform initialization for those instance variables.

interface: * every variable is always public, static and final so there is no chance of instance variable inside interface. So we should initialize at time of declaration
* So constructor is not required

eg: abstract class Person
{ String name;
int age, height, weight;

Person (String name, int age, int height, int weight)
{ this.name = name;
this.age = age;
this.height = height;
this.weight = weight; }
}

Class Student extends Person{
int rollNo;
int marks;
Student (String name, int age, int height, int weight, int rollNo,
int marks)
{ super (name, age, height, weight, rollNo);
this.rollNo = rollNo;
this.marks = marks; }
}

Q8. Can reference be created for abstract class?
Person p = new Student ("Sachin", 49, 56f, 71, 10, 100);

Q9. Can reference be created for interface?
ISample sample = null;

Note: Every method present inside interface is abstract, but in abstract class also we take only abstract methods then what is need of interface concept?

```
abstract class Sample{
    public abstract void m1();
    public abstract void m2();}

interface ISample{
    void m1();
    void m2();}
```

→ We can replace interface concept with abstract class, but it is not a good programming practise

eg: 1.	eg: 2
interface X { .... }	abstract X { .... }
Class Test implements X { .... }	Class Test extends X { .... }
Test t = new Test();	Test t = new Test();
* performance is high * while implementing X we can extends one more class, through which we can bring re usability	* performance is low * while extending X we can't extends any other classes so re usability is not brought.

Note: if everything is abstract then it is recommended to go for Interface.

Wrapper Class

Purpose: (i) To wrap primitives into object form so that we can handle primitives also just like objects.
(ii) To define several utility functions which are required for the primitives.

```
int a = 10;
    ↑
Primitive type
```

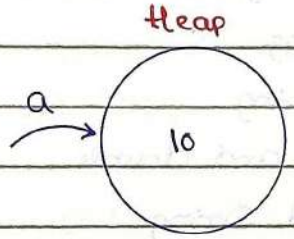
4 bytes.

a	10

local variable : → Stack
instance variable : → heap
Static variable : → method Area (Heap Area)

JDK 1.5V Wrapper Class are introduced

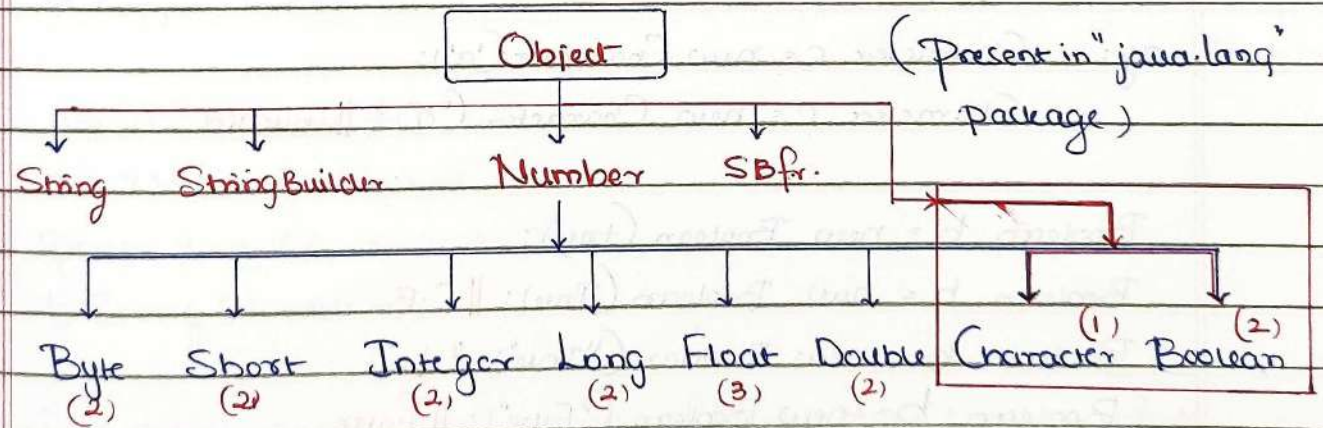
```
Integer a = 10;
    ↑
reference type
```



- parseInt()
- toString()
- valueOf() ...

} and many more methods available

Memory allocated on heap so no size limit.



* Object ← toString() : returns the hashCode value of the object.
* toString() : → Overridden to print the data present in the object.
* equals() : → Overridden to compare the content present in the object.

eg: Integer i1 = new Integer (10);
Sysout (i1); // 10 (toString())
Integer i2 = new Integer ("10");
Sysout (i2); // 10 (toString()).

* If String argument is not properly defined then it would result in RunTime Exception called "NumberFormatException".
eg: Integer i = new Integer ("ten"); // RE

Wrapper class and its associated constructor

Byte → byte and String
Short → short and String
Integer → int and String
Long → long and String
Float → float, String and double
Double → double and String
Character → Character
Boolean → boolean and String

eg: Character c = new Character ('a');
Character c = new Character ("a"); // invalid

Boolean b = new Boolean (true);
Boolean b = new Boolean (True); // C.E
Boolean b = new Boolean ("True"); // true
Boolean b = new Boolean ("False"); // false
Boolean b = new Boolean ("nitin"); // false

* If we are using Boolean, boolean value will be treated as true w.r.t insensitive part of "true", for all others it would be treated as "false".

Note: * If we are passing String argument then case is not important and content is not important.
* If the content is case sensitive String of true then it is treated as true in all other cases it is treated as false.

* In case of Wrapper Class, toString() is overridden to print the data.
* In case of Wrapper class, equals() is overridden to check content.
* Just like String class Wrapper class are also treated as "Immutable Class".

Immutable Class:

If we create an object and if we try to make a change, with that change new object will be created and those changes will not reflect in old copy.

Qio Can we make our undefined class as Immutable?
Ans Yes, by making the class final.

Wrapper Class Utility methods

1. valueOf() method.
2. XXXValue() method.
3. parseXxx() method
4. toString() method.

(i) public static Wrapper valueOf(String data, int radix);
(ii) public static Wrapper valueOf(String data);
(iii) public static Wrapper valueOf(int data);

} throws NumberFormatException.

1 valueOf() method:

* To create a wrapper object from primitive type or

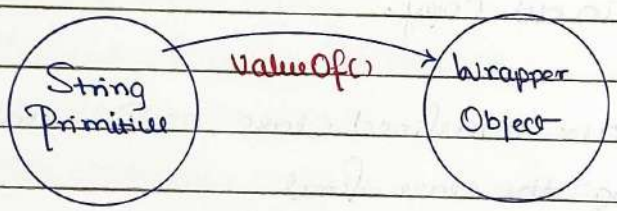
String we use valueOf().

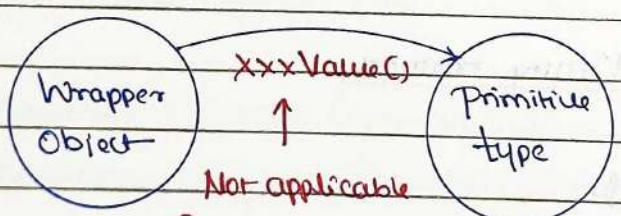
* It is alternative to constructor of wrapper class, not suggestion to use.
* Every wrapper class, except character class contain static valueOf() to create a wrapper Object.

(i)

eg: Integer i1 = Integer.valueOf("1111");
Sysout(i1); //1111
Integer i2 = Integer.valueOf("1111", 2);
Sysout(i2); //15
Integer i3 = Integer.valueOf("ten"); // RE: NumberFormatExc.

eg (ii) Integer i1 = Integer.valueOf(10);
Double d1 = Double.valueOf(10.5);





Not applicable
for 'char' and 'boolean'.

2. xxxValue()

We can use xxxValue() to get primitive type for the given wrapper object. These methods are part of every Number type Object. All these classes have 6 methods.

eg:

Integer i = new Integer(130);
Sysout(i.byteValue()); //-126
Sysout(i.shortValue()); //130

```
Sysout (i.intValue());  //130
Sysout (i.longValue());  //130
Sysout (i.floatValue());  //130.0
Sysout (i.doubleValue());  //130.0
```

3. charValue()

Character class contains charValue() to get Char primitive for the given Character object.

eg: Character c = new Character('c');
Char ch = c.charValue();

4. booleanValue()

Boolean class contains booleanValue() to get boolean primitive for the given boolean object.

eg: Boolean b = new Boolean("nitin");
boolean b1 = b.booleanValue();
Sysout(b1); // false

In total xxxValue() are 36 in number

xxxValue() ⟶ Convert Wrapper Object ⟶ Primitive

5. parseXXXX()

We use parseXXXX() to convert String object into primitive type.

eg: int i = Integer.parseInt("10");
double d1 = Double.parseDouble("10.0");
boolean b = Boolean.parseBoolean("true");

* Every wrapper class, except Character class has parseXXX() to convert String into primitive type.

eg: 2. WAP to take input from Command line and perform arithematic operations.

```
int i1 = Integer.parseInt(args[0]);
int i2 = Integer.parseInt(args[1]);
Sysout((i1*i2)+(i1-i2));
```

form-2: public static primitive parseXXX(String s, int radix)

radix → range from 2 to 36

* Every integral type wrapper class (Byte, Short, Int, Long) contains the following parseXXX() to convert specified radix String to primitive type

eg: `int i = Integer.parseInt("111",2);` //15

6 toString()

: To convert wrapper object or primitive to String. Every wrapper class contain toString().

form 1: public String toString()

1. Every wrapper class (including Character) contains above method to convert wrapper object to String.
2. It is the overriding version of the Object class toString() method.
3. Whenever we are trying to print wrapper object reference internally this "toString()" method only executed.

eg: `Integer I = Integer.valueOf("10");`

form 2: public static String toString(primitive type)

Every wrapper class contains a static toString() method to convert primitive to String.

eg: `String s = Integer.toString(10);`

String s = Character.toString('a');
String s = Boolean.toString(true);

form 3: Public static String toString (primitive p, int radix)

Integer and long classes contain the following static toString() method to convert the primitive to specified radix string form.

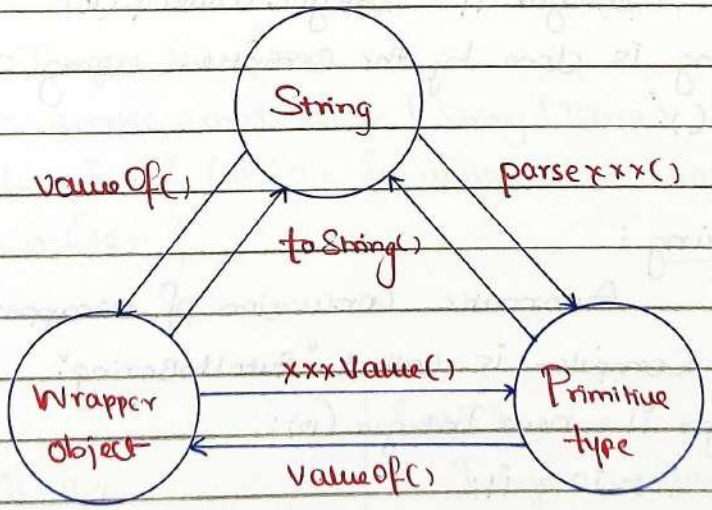
eg: String s = Integer.toString(15,2);
Sysout(s); // 1111

form 4:

Integer and Long classes contain the following toXxxString() methods:

Public static String toBinaryString (primitive p);
Public static String toOctalString (primitive p);
Public static String toHexString (primitive p);

eg: String s1 = Integer.toBinaryString(7); // 111
String s2 = Integer.toOctalString(10); // 12
String s3 = Integer.toHexString(10); // a



Note: String data = String.valueOf('a'); // static factory methods
String data = "Sachin".toUpperCase(); // instance factory methods

AutoBoxing and Auto Unboxing

Until 1.4 Version, we can't provide wrapper class objects in place of primitive and primitive in place of wrapper object, all the required conversions should be done by the programmer. But from JDK 1.5 version onwards, we can provide primitive in place of wrapper and inplace of wrapper we can keep primitive also.

All the required conversions will be done by the compiler automatically, this mechanism is called "AutoBoxing" and "AutoUnboxing".

eg: ArrayList al = new ArrayList();
al.add(10);

Autoboxing:

Automatic conversion of primitive type to wrapper object by the compiler is called "AutoBoxing".

```
Integer i1 = 10;
        ↓ After compilation the code would be
Integer i1 = Integer.valueOf(10);
```

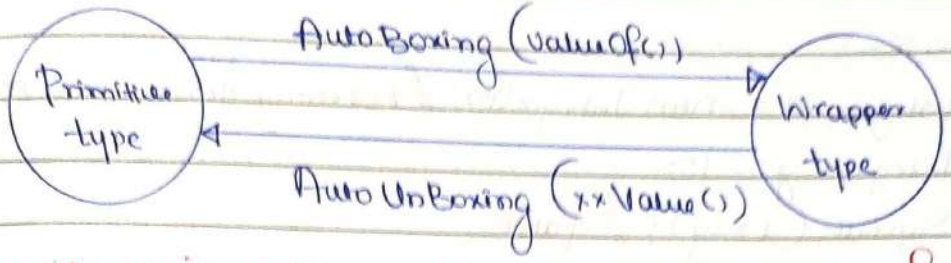
AutoBoxing is done by the compiler using a method called "valueOf()".

AutoUnboxing:

Automatic conversion of wrapper object to primitive type by Compiler is called "AutoUnBoxing".

```
Integer i1 = new Integer(10);
int i2 = i1;
        ↓ Compiler converts Integer to int
int i2 = i1.intValue();
```

AutoUnBoxing is done by compiler using a method called "xxxValue()";



Compiler will automatically do the conversions from Jdk 1.5 version

eg
```
Class Test
{   Static Integer i1=10; //AutoBoxing

    public static void main(String[] args)
    {  int i2 = i1; //AutoUnBoxing
       m1(i2); }

    public static void m1(Integer i2) //AutoBoxing
    {   int k = i2; //AutoUnBoxing
        System.out.println(k); } //10
}
```

eg 2
```
Class Test
{   Static Integer i1; //null
    Public static void main(String [7arge)
    {  int i2 = i1; // int i2 = i1.intValue() :: Null Pointer Exception
       Sysout(i2); }
}
```

Case 3:
```
Integer i1=10;
Integer i2=i1; i1++; //11
Sysout(i1+" "+i2);//10
Sysout(i1==i2);//false
```

Case 4:
```
Integer x= new Integer(10);
Integer y= new Integer(10);
Sysout(x==y); //false
```

Case 5:

```
Integer x = new Integer(10); // memory from heap area
Integer y = 10;
Sysout(x==y); // false
```

Case 6

```
Integer x = new Integer(10);
Integer y = x; // reference is used so pointing to same object
Sysout(x==y); // true
```

Case 7:

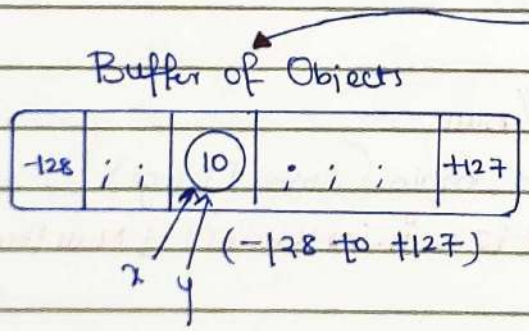
```
Integer x = 10;
Integer y = 10;
Sysout(x==y); // true
```

```
Integer i = 1000;
Integer j = 1000;
Sysout(i==j); // false
```

* Compiler uses "valueOf()" for AutoBoxing

↑

Implemented in intelligent way in wrapper class



At the time of loading the class file JVM buffer with already the objects which are to be used during AutoBoxing range (-128 to 127)

Note:

1. To implement autoboxing concept in wrapper class a buffer of object will be created at the time of class loading.
2. During Autoboxing if an object has to be created first JVM will check weather the object is already available inside buffer or not.
3. If available JVM will reuse buffer object instead of creating one.

4. If the object is not available inside buffer, Jvm will create a new object in the heap area, this approach improvised the performance and memory utilization.

But this buffer concept is applicable for two cases

1. Byte, Short, Integer, Long : -128 to +127
2. Character : 0 to 127
3. Boolean : true, false

In remaining cases new object will be created

eg:

```
Integer x=128;
Integer y=128;
Sysout(x==y); // false
```

```
Integer a=127;
Integer b=127;
Sysout(a==b); // true
```

```
Boolean b1=true;
Boolean b2=true;
Sysout(b1==b2); // true
```

```
Double d1=10.0;
Double d2=10.0;
Sysout(d1==d2); // false
```

Code Snippets

1.
```
final int i1=1;
final Integer i2=1; // memory will be decided at runtime because it is wrapper class object.
final String s1=":ONE";

String str1=i1+s1, str2=i2+s1;
Sysout(str1=="1:ONE"); // true
Sysout(str2=="1:ONE"); // false
```

2.
```
String javaworld="Javaworld", java="Java", world="world"; // scp
java=world; // Jvm → Javaworld (heap area)
Sysout(java==javaworld); // false
```

3. StringBuilder sb = new StringBuilder("Space Station");
sb.delete(5,6).insert(5,'$').toString().toUpperCase();
Sysout(sb); // Space Station

4. String s1 = "OCP", s2 = "ocp";
Sysout(_____) What should be added to print true?
Ans: s1.equalsIgnoreCase(s2), s1.length == s2.length()

5. String str = "PANIC"; StringBuilder sb = new StringBuilder("THE");
Sysout(str.replace("N", sb)); // PATHETIC

6. boolean f1 = "Java" == "Java".replace('J','J'); // true
boolean f2 = "Java" == "Java".replace("J","J"); // true
Sysout(f1 && f2); // true.

7. StringBuilder sb = new StringBuilder("TOMATO");
Sysout(sb.reverse().replace("O","A"); // Compilation error

8. String[] Strings = "iNeuron-Technology-Private-Known-for-Java".
split("-",3);
↑ Specified index for an array.
for(String String : Strings) Sysout(String);
Output: iNeuron
Technology
Private-Known-for-Java
} Because 3 indexes are specified in split.

9. String s1 = "null"+null+1; Sysout(s1); // nullnull1

10. Sysout(1+null+"null"); // Compile time error

11. String[] strings = {"Java", "Hibernate", "Spring"};
String l = String.join("-", strings); // Java-Hibernate-Spring

Var arg method

It stands for variable argument methods. In Java if we have variable number of arguments, then compulsorily new method has to be written till JDK 1.4 version.
But in JDK 1.5 version, we can write single method which can handle variable no. of arguments but all of them should be of same type.

Syntax: methodOne(dataType ... variableName)
... → It stands for "ellipse"

eg: public void int add(int... x)
(...) JVM internally uses array representation to hold values of x

Object.add(); → new int[]{ }
Object.add(10); → new int[]{10}
Object.add(10,20); → new int[]{10,20}

eg2
```
class Demo
{  public void add(int... x)
   { int total=0;
     for(int i=0; i<x.length; i++) total+=x[i];
     System.out.print(total); }

  public static void main(String[]args)
  {  Demo d= new Demo();
     d.add(); // 0
     d.add(10); // 10
     d.add(10,20,30); // 60 }
  }
```

Valid Signatures

1. void add(int... x)
2. void add(int... x)
3. void add(int ...x)

Case 2 : We can mix normal argument with var argument.

public void methodOne (int x, int...y) ✓

public void methodOne (String s, int...x) ✓

void methodOne (int...x, String s) // Invalid

Case 3 : While mixing var arg with normal argument var arg should always be last.

public void add (int...a, String b) Invalid.

Case 4 : In an argument list there should be only one var argument.

public void add (int...x, int...y) Invalid

Case 5 : We can overload var arg method, but var arg method will get a call only if none of matches are found (just like "default" of switch case).

```
eg: Class Test
{ public void m1 (int...x)
    { Sysout ("var arg method"); }

  public void m1 (int x)
    { Sysout ("int method"); }

  public static void main (String[] args)
  { Test t = new Test();
    t.m1(); // var arg method
    t.m1(10,20); // var arg method
    t.m1(10); } // int method
}
```

Case 6 : public void m1(int...x) → it can't be replaced as int[]x but vice versa.

Case 7 :

public void m1(int...x)

public void m1(int[]x) // CE.

We cannot have two methods with same signature

Single dimension array v/s Var Args method

1. Whenever Single dimension array is present we can replace it with Var arg.
   eg: public static void main(String[] args) → String... args

2. Whenever var arg is present we cannot replace it with Single dimension array.
   eg: public void m1(String... args) → String[] args (invalid)

Note:

m1(int...x) → We can call to this method by passing group of int values and it will become 1D array.

m1(int[]x) → We can call to this method by passing 1D array only

eg: 1. public void m1(int...x){...}

Test t = new Test();

t.m1(10,20,30); // Treated as 1D array

2. public void m1(int[]...x)

int[] a = {10,20,30}; int[] b = {40,50};

Test t = new Test();

t.m1(a,b); // Treated as 2D array

Wrapper Class

1. AutoBoxing
2. Widening (implicit typecasting done by compiler for both primitive and wrapper class).
3. Var-arge.

Case 1: Widening v/s AutoBoxing

```
Class Test
{  public static void m1(long l)
     { Sysout("widening"); }

   public static void m1(Integer i)
     { Sysout("autoboxing"); }

   public static void main(String[] args)
   {   int x=10;
       m1(10); } // int ⟶ implicit type casting ⟶ long
}
```

Output: widening

Case 2: Widening v/s Var-arg method

```
public static void m1(long l)
  { Sysout("widening"); }
public static void m1(int... i)
  { Sysout("var-arg method"); }

public static void main(String[] args)
  {  int x=10;
     method m1(10); } // int ⟶ typecasting ⟶ long
```

Output: widening

Case 3: Autoboxing v/s var arg method

```
public static void m1(Integer i)
  { Sysout("autoboxing"); }
public static void m1(int... i)
  { Sysout("var-arg method"); }

public static void main(String[] args)
  { int x = 10; m1(x); } // int → type casting → long, float, d
  // int → autoboxing → Integer
```

Output: autoboxing.

Case 4:

```
public static void m1(Long l)
  { Sysout("long"); }
public static void main(String[] args)
  { int x = 10; m1(x); // CE: Can't find the method.
```

* Widening followed by autoboxing is not allowed in Java, but autoboxing followed by widening is allowed.

Case 5:

```
public static void m1(Object o)
  { Sysout("Object"); }

public static void main(String[] args)
  { int x=10; m1(x); } // Autoboxing → int → Integer
  // Widening → Integer → Number, Object
```

Output: Object

Valid declarations and invalid declarations:

1. int i=10; ✓

2. Integer I = 10; ✓ Autoboxing (valueOf())
3. int i = 10L; ✗ long → int
4. long l = 10L; ✓ Autoboxing
5. long l = 10; ✗ Autoboxing → Integer, Number so invalid.
6. long l = 10; ✓ int → long
7. Object o = 10; ✓ Autoboxing → Integer → Object
8. double d = 10; ✓ int → double
9. Double d = 10; ✗ Autoboxing → Integer → Number, Object
10. Number n = 10; ✓ Autoboxing → Integer → Number

new v/s newInstance

1. new is an operator to create objects, if we know class name at the beginning then we can create an object by using new operator
2. newInstance() is a method presenting class "Class", which can be used to create object.
3. If we don't know the class name at the beginning and its available dynamically Runtime then we should go for newInstance() method.

eg: 1.
```
public class Test
{ public static void main(String[] args) throws Exception
  { // take input of classname for which object has to be
    created at the runtime.
    String className = args[0];
    // load class file explicitely
    Class c = Class.forName(className);

// for the loaded class object is created using zero param constructor
    Object obj = c.newInstance();
```

```
// perform type casting to get Student object
Student std = (Student) obj;
System.out.println(std); }
}
```

Args (cmd) : java Test Student.

```
Class Student
{   Static {
        Sysout ("Student.class file is loading"); }
    public Student()
    { Sysout ("Student Constructor is called"); }
}
```

Output : Student.class file is loading
Student Constructor is called
Student@....

Note:

* If dynamically provide class name is not available then we will get the Runtime Exception saying "ClassNotFoundException".
* To use newInstance() method compulsory corresponding class should contain no argument constructor, otherwise we will get the Runtime Exception saying "InstantiationException".
* If the argument constructor is private then it would result in "IllegalAccessException".
* During typecasting if there is no relationship b/w two classes as parent to child then it would result in "ClassCastException".

Difference between new and newInstance()

new : * new is an operator, which can be used to create an object.
* We can use new operator if we know the class name in the beginning
* If the corresponding .class file is not available at the

Runtime then we will get Runtime Exception saying "No Class Def Found Error", It is unchecked.

To used new operator the corresponding Class not required to contain no argument Constructor.

newInstance() : * newInstance() is a method, present in Class "Class" used to create an object

* We can use the newInstance() method, if we don't write class name at the beginning and available dynamically Runtime.
* Object o = Class.forName(args[0]).newInstance();
* If the corresponding .class file not available at runtime then we will get runtime exception saying "ClassNotFoundExcep", it is checked.
* To used newInstance() method the corresponding class should compulsory contain no Runtime Exception saying Instantiation Exception.

Difference between ClassNotFoundException and NoClassDefFoundError :

1. For hard coded class names at Runtime in the corresponding .class files not available we will get NoClassDefFoundError, which is unchecked

Test t = new Test();

In Runtime Test.class file is not available then we will get NoClassDefFoundError

2. For dynamically provided class name at Runtime, if the corresponding .class files is not available then we will get the Runtime Exception saying "ClassNotFoundException".

Ex: Object o = Class.forName("Test").newInstance();

At runtime if .class file not found we get ClassNotFoundExc.

Note:

new will Create memory on the heap area

Student :→ Jvm will Search for .class file in current working directory if found loads the file into Method Area.

During the loading of .class file

a. Static variables will get memory set with default values
b. Static block gets executed

In the heap area, for the required object memory for instance variables is given jvm will set the default values to it

a. Execute the instance block if available
b. Call the Constructor to set the meaningful values to the instance variables

Jvm will give the address of the Object to hashing algorithm which generates the hashCode for the object and that hashCode will be returned as the reference to the programmer

Import Statements:

```
Class Test
{ public static void main (String arg[])
  { ArrayList l = new ArrayList(); }
}
```

Output: Compile time error (Cannot find Symbol)

* We can resolve this problem by using fully qualified name "java.util.ArrayList" l = new java.util.ArrayList(); But problem is we need to use this name everytime and increased length of code and reduces readability.
* We can resolve this problem by using import Statements

Example:
```
import java.util.ArrayList;
class Test{
  public static void main(String[]args)
    { ArrayList l = new ArrayList();}
}
```

* Hence whenever we are using import statements it is not required to use fully qualified names, we can use short names directly.
* This approach decreases length of code and improves readability

Case 1: Types of import statements
1) Explicit class import
2) Implicit class import

Explicit class import:
eg: Import java.util.ArrayList;
* This type of import is highly recommended because it improves the readability of the code.
* Best suitable for developers where readability is important.

Implicit class import:
eg: import java.util.*;
* It is not recommended to use because it reduces the readability of the code.
* Best suited for students where typing is important.

Case 2 Which of statements are meaningful: ?
a. import java.util;
b. import java.util.ArrayList.*;
c. import java.util.*;
d. import java.util.ArrayList;

Implicit Import	Explicit Import
import java.util.*;	import java.util.Arraylist;
Arraylist al	Arraylist al
Compilation Time ↑	Compilation Time ↓

Case 3 Class MyArraylist extends java.util.Arraylist
{ }

* The code compiles fine eventhough we are not using import statements because we used fully qualified name.
* Whenever we are using fully qualified name it is not required to use import statement.
* Similarly whenever we are using import statements it is not required to use fully qualified name.

Case 4
```
import java.util.*;
import java.sql.*;
Class Test{
    public static void main (String [] args)
    { Date d= new Date(); }
}
```
Output: Compile time error
Reference to Date is ambiguous.

Even in list case also we may get the same ambiguity problem because it is available in both util and awt packages.

* JDK software is an API code
API : collection of .class files (class/interface/enum)

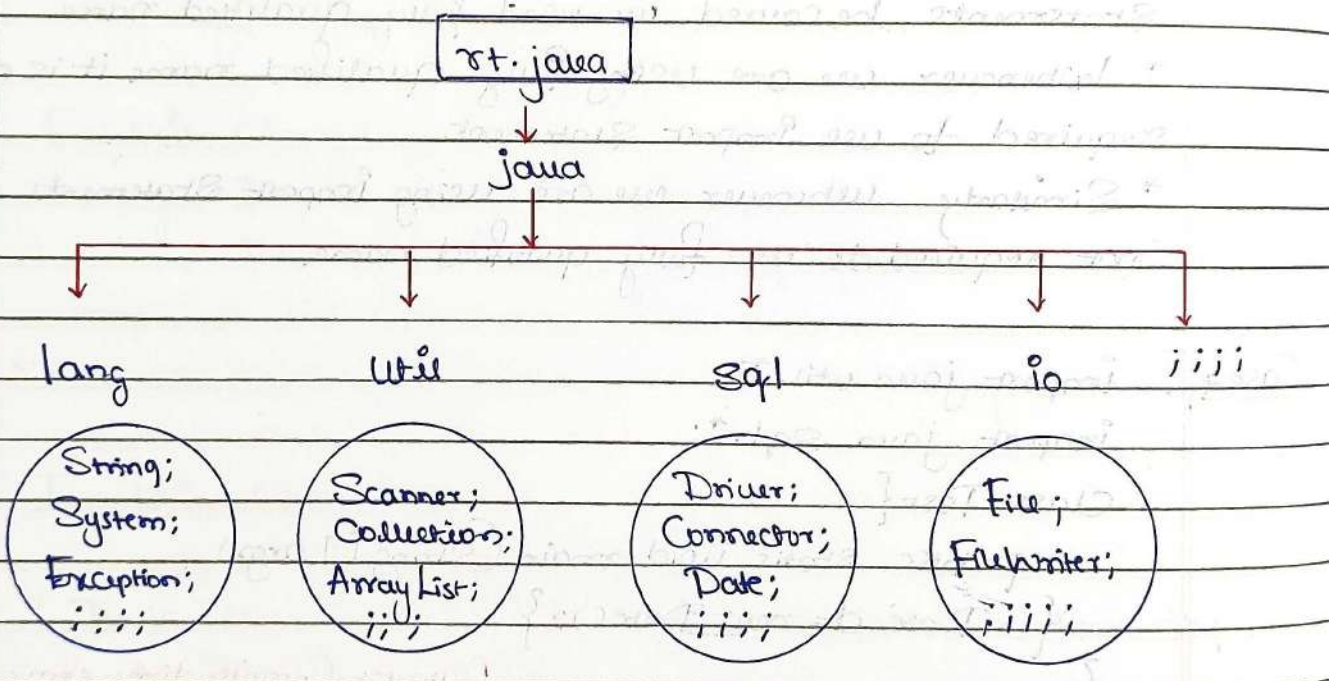
↑ Zipping

JAR file (Java Archive File)

↓ converted into

Learner → install Software → .exe file (JDK/w)

* Soooo .class files are present, for maintainence and easy use they created folder and keep the .class files, these folders are called as "packages" in java.



→ Need to inform compiler and jvm about these classes through "import"

Cases: While resolving class names compiler will always gives the importance in the following order.

1. Explicit class import
2. Classes present in the current working directory

3 Implicit class import

eg:

```
import java.util.Date;
import java.sql.*;
class Test{
    public static void main(String args[])
  { Date d= new Date(); }
}
```

The code compiles fine and in this case util package Date will be considered.

Case 6 Whenever we are importing all/ a package all classes and interfaces present in that package are by default available but not sub package classes.

java
- util
  - Scanner class, ArrayList.class, LinkedList.class
  - regex
    - Pattern.class

To use Pattern class in our program directly which import statement is required?

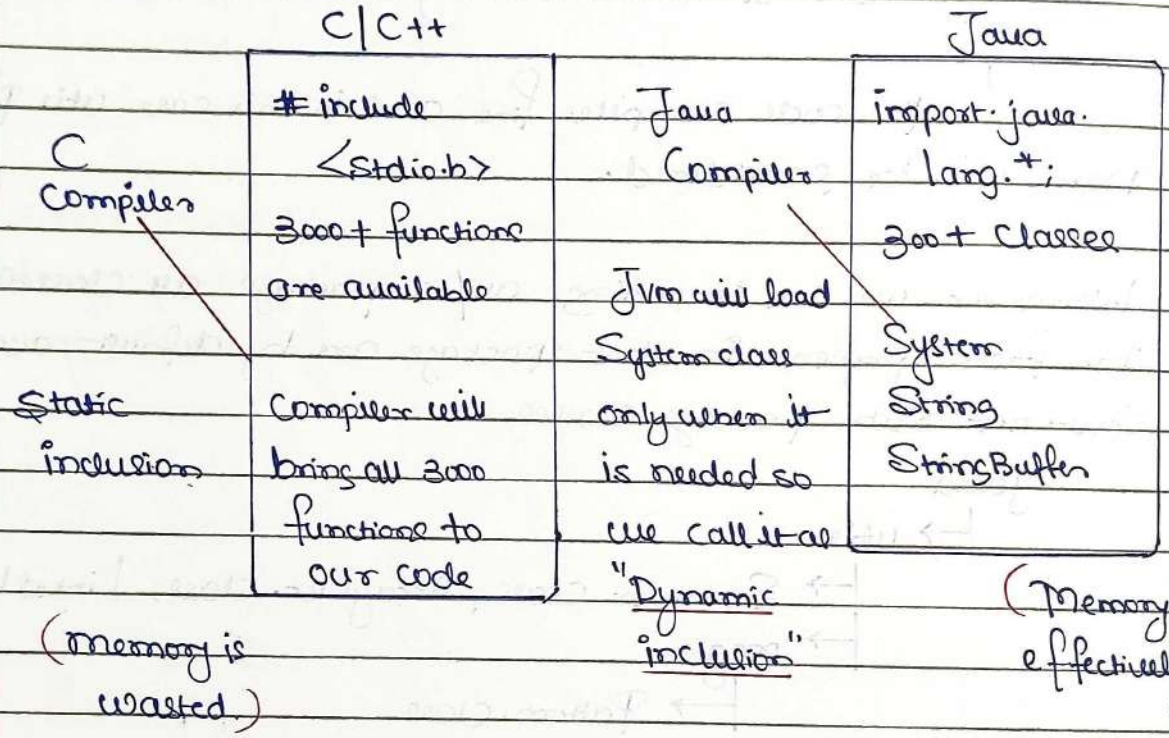
Ans import java.util.regex.*; (implicit import)
import java.regex.Pattern; (explicit import)

Case 7 In any java program the following 2 packages are not require to import because there are available by default to every java program.

1. java.lang package
2. default package (current working directory)

Case 8 "Import Statement is totally Compile time concept" if more no. of imports are there then more time will be compile time but "no change in execution time."

Difference between C language #include and java language import?



	#include	import
1.	It can be used in C and C++.	It can be used in java
2.	At compile time only compiler copy the code from Std library and placed in curr. program.	At runtime Jvm will execute the corresponding Std library and use its result in curr. program.
3.	It is Static inclusion	It is dynamic inclusion
4.	Wastage of memory	No wastage of memory

Note: In the case of C language #include: all the header files will be loaded at the time of include statement hence it favours Static loading.

* But in java import statement number of ".class" will be loaded at the time of import statements in the next line of code whenever we are using a particular class then only corresponding ".class" file will be loaded.
-Hence it follows "dynamic inclusion" or "load on demand" or "load on fly".

JDK 1.5 Version's new features:

1. For-Each	6. Co-variant return types
2. Var-arg	7. Annotations
3. Queue	8. Enum
4. Generics	9. Static import
5. Autoboxing and Autounboxing	10. String Builder

Static import:

It was introduced in JDK 1.5 versions. According to Sun microSystems: Static import improves readability of code but according to world wide programming experts: Static import creates confusion and reduces readability of the code. Hence if there is no specific requirement it is not recommended to use Static import.

Usually we can access static members by using class name but whenever we are using static import it is not required to use class name, we can access methods directly.

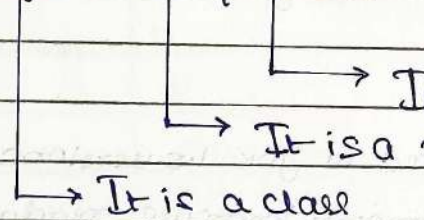
Without Static import:
```
class Test{
    public static void main(String[] args)
    { System.out.println(Math.sqrt(4)); //2
      System.out.println(Math.max(10,20)); } //20
}
```

With Static import:

```
import static java.lang.Math.sqrt;
import static java.lang.Math.*;
class Test{
  public static void main(String[]args)
  { Sysout(sqrt(4)); //2.0
    Sysout(max(10,20)); }//20
}
```

eg:
```
class Test{
    static String name="Sachin"; }
Test.Name.length() //6
```

eg System.out.println()



eg:
```
import static java.lang.Integer.*;
import static java.lang.Byte.*;
class Test
{ public static void main(String[]args)
  { Sysout(MAX_VALUE); }
}
```

Output: Compile time error

Note: Two packages contain a class or interface with the same is very rare hence ambiguity problem is very rare in normal import.

*But 2 classes or interfaces can contain a method or variable with the same name is very common hence ambiguity.

Problem is also very common in Static import.

* While resolving Static members Compiler will give the precedence in the following order:
  1. Current Class Static member
  2. Explicit Static import
  3. Implicit Static import.

eg:
```
import Static java.lang.Integer.MAX_VALUE;
import Static java.lang.Byte.*;
Class Test{
    Static int MAX_VALUE = 999;
    public Static void main(String [] args)
    { Sysout(MAX_VALUE); }
}
```

Which of the following Statements are valid?

```
import java.lang.Math.*; //invalid
import Static java.lang.Math.*; //valid
import java.lang.Math; //valid
import Static java.lang.Math; //invalid
import Static java.lang.Math.Sqrt.*; //invalid
import java.lang.Math.Sqrt; //invalid
import Static java.lang.Math.Sqrt(); //invalid
import Static java.lang.Math.Sqrt; //valid
```

Usage of Static import reduces readability and creates confusion hence if there is no specific requirement never recommend to use Static import.

Difference between general import and Static import.

Normal import:

* We can use normal imports to import classes and interface of package.

* Whenever we are using ~~static~~ normal import we can access class and interface directly by their short name, it is not required to use fully qualified names.

Static import:

* We can use static import to import static members of a particular class
* Whenever we are using static import it is not required to use class name, we can access static members directly.

Functional Interface:

An interface having only one abstract method is a functional interface.

eg:

```
@FunctionalInterface //indication to Compiler (annotation)
interface Demo
{ void disp(); }
```

Note: Lambda expressions and functional interface, they work together.

Lambda Expression:

In Java 8 a new operator was introduced

→ — arrow operator / lambda operator to write lambda expression.

eg:

```
interface Demo
{ void disp(); }

public class Launch{
  public static void main(String[] a)
  { Demo d = ()→ System.out.println("Hello"); // need brackets for multi. statements
    d.disp(); }
}
```

Output: Hello

eg.
```
interface Demo
{ public void disp(); }

public class Launch{
    public static void main(String[] args)
    {
        //Demo d = new Demo(); // not valid
        Demo d = new Demo() { // implementation of functional interface without "implements".
//Anonymous                 void disp()
method approach.            { Sysout("Hello"); }
                        };
                        // multiple methods can be implemented like this from a normal interface.
        d.disp();
    }
}                       // you cannot write more than one method in func. interf.
```

eg.
```
@FunctionalInterface
interface Add
{ void add(int a, int b); }

@FunctionalInterface        interface Sub
{ void                      int Sub(int num1); }

public class LaunchLambda{
    Add add = (a,b) -> {    // implementing Add interface
                int res = a+b;  // writing data type of
                Sysout(res); }; parameters is optional
    add.add(10,20); //20

    Sub sub = num1 -> { // implementing Sub interface
                int res = num1-5; // no need of parenthesis
                return res; };      for single parameter.
```

```
//Sub sub = num1 -> { return num1-5; }; curly brackets req.
        // valid lambda expression, no need to specify
           the data type of parameters,
//Sub sub = num1 -> num1-5; // bracket not req, cos no return.
        // no need to write return statement, Compiler will
           automatically detect the return type and return.

    Sub.sub(10); //5; }
}
```

Key points about lambda expressions:

1. To write lambda expression we use lambda operator (→).
2. Lambda operator divided into two parts to write lambda exp:
   left side of lambda operator we write parameters required.
   right side we write body or implementation.
3. Left side for parameters declaring/writing data types is optional.
4. Right side if implementation/body has one statement then { } is optional.
5. Left side if parameter is single the () is optional.
6. Right side in body if its single line implementation then return statement is also optional.
7. { } is mandatory if there are more than one statement and also if there is return statement explicitly used by the developer.

WAP to compute length of String:

```
@FunctionalInterface
interface CLS
{ int getLength(String s); }
```

```
public class Launch{
    public static void main (String[] Str)
    { CLS sl = Str → Str.length(); // lambda expression
      Sysout( sl.getLength("Vivek")); }
}
```

Output : 5

Exception Handling

Exception handling in java is one of the effective means to handle runtime errors so that the regular flow of the application can be preserved. Java Exception handling is a mechanism to handle runtime errors.

Exception is an unwanted or unexpected event, which occurs during execution of a program at runtime that distrupts the normal flow of program instructions. Exceptions can be caught and handled by the program. (Default Exception Handler).

Major reasons why an exception occure:

* invalid user input	* Physical limitations
* device failure	* Code errors
* loss of network connection	* Opening an unavailable file.

When an exception occure within a method, it creates an object. This object is called exception object. It contains information about the exception, such as the name and description of the exception and state of the program when the exception occured. If the exception is not handled by the developer, then the object will go to the "Default Exception Handler" else if try and Catch blocks are given by the developer then Jvm will not go to "Default Exception Handler".

Example 1

```
import java.lang.util.*;

Sysout("Connection Established");
try{
    Scanner scan = new Scanner(System.in);
    int num1 = Scan.nextInt();
    int num2 = Scan.nextInt();
    int res = num1/num2;
    Sysout("The result is" + res); }

Catch (Exception e) // General exception
{ Sysout("You are dividing by zero"); }
```

Input: 10 5
Output: The result is 2

Input: 10 0
Output: You are dividing by zero

Examp. 2

```
Sysout("connection established");
try{
    Scanner Sc = new Scanner(System.in);
    Sysout("Enter 1st number");
    int num1 = Sc.nextInt(); // num1 input
    Sysout("Enter 2nd number");
    int num2 = Sc.nextInt(); // num2 input
    int res = num1/num2;
Sysout("Result is :" + res); // Executes if exception not occurs

    Sysout("Enter array Size");
    int size = Scan.nextInt(); // Size input for array
    int [] a = new int [size]; // array initialization

    Sysout("Enter element to be inserted");
      int ele = Sc.nextInt();
    Sysout("Enter position"); // position should be from
      int pos = Sc.nextInt(); 0-(size-1),
```

```
a[pos] = ele;
Sysout ("Element is Inserted"); }

Catch (ArithmeticException ae)          // Specific catch blocks are
{ Sysout ("Dividing by zero"); }          executed, rest are not
                                          executed
catch (NegativeArraySizeException nae)
{ Sysout ("Please be positive"); }      // "Exception" is the parent
                                          of all exception is kept
Catch (ArrayIndexOutOfBoundeException a)  at last.
{ Sysout (" Be in your limits"); }

Sysout ("connection terminated");
```

Input:

Connection Established
Enter 1st number 100
Enter 2nd number 0
Dividing by zero
Connection terminated

Testcase 2:

Connection Established
Enter 1st number 50
Enter 2nd number 5
The result is 10

Enter array size 5
Enter element to insert 500
Enter position 5
Be in your limits
Connection terminated

Testcase 3:

Connection established
Enter 1st number 70
Enter 2nd number 7
The result is 10
Enter array size -5
Please be positive
Connection terminated.

Note:
* Single try block and multiple catch blocks are allowed.
* Corresponding catch block will be called and rest will not be executed.
* As a developer you need to give generic exception "Exception" for default.

Key points:

* In java to handle exception we use try and catch blocks
* Catch block will be executed only if there is an exception in try block otherwise it will not.
* If there is an exception, then the statements below the statement where the exception has occured will not be executed.
* One try block can have multiple catch blocks
* When we are writing catch blocks specific to every kind of exception, it is recommended to use generic catch block
* The generic catch block must be at the end

Whenever there is an Exception:

1. Handle exception (try and catch block)
2. Duck the exception (throws)
3. Re-throwing an exception (throw, throws, try, catch, finally)

Exceptions can be categorized in two ways:

1. Built in Exceptions: Built in exceptions are the exceptions that are available in Java libraries.
   (a) Checked exceptions: Checked exceptions are called Compile time exceptions because the exceptions are checked at Compile time by the compiler.
   (b) Unchecked exceptions: The unchecked exceptions are just opposite to the checked exceptions. The compiler will not check these exceptions at compile time.

2. User defined exceptions: Sometimes, the built in exceptions in Java are not able to describe a situation. In such cases users can also create exceptions, which are called 'User-defined exceptions'.

Example

```
import java.util.Scanner;

Class Alpha
{   void alpha() throws ArithmeticException
    {   System.out("Connection established");
        Scanner Scan = Scan.nextInt();
        System.out("Enter first number");
        int num1 = Scan.nextInt();
        System.out("Enter second number");
        int num2 = Scan.nextInt();
        int res = num1/num2;
      System.out.println("The res is" + res);
      System.out.println("Connection is terminated"); }
}

Class Beta
{   void beta() throws ArithmeticExpression
    {   Alpha a = new Alpha();
        a.alpha(); }
}

public class Launch
{   public static void main(String[] args)
    {
      try{
          Beta b = new Beta();
          b.beta(); }
      Catch (ArithmeticException e)
      {   System.out.println(e.getMessage());
          System.out.println("Exception finally handled
                              in main"); }
    }
}
```

// throws keyword throws the exception to where called it and handled where catch block is there.

// if catch block is within the method, then exception is handled and main Catch is not executed.

Input: 100 0

Output:

" Exception finally handled in main."

Example

```
import java.util.Scanner;
// Re-throwing an exception
Class Alpha1
{  void alpha() throws ArithmeticException
   {  System.out.print("Connection Established");
      try
      {  Scanner SC = new Scanner(System.in);
         Sysout("Enter first number");
         int num1 = SC.nextInt();
         Sysout("Enter second number");
         int num2 = SC.nextInt();
         int res = num1/num2;
         Sysout("The result is "+res); }

      Catch (ArithmeticException e)
   {  System.out.println("Exception handled in alpha");
      throw e; } // rethrowing the exception to the method where
                    Alpha1 was created
      finally
   {  System.out.println("Connection is terminated"); }
         // finally will execute after the exception is handled
   }
};
   public class Launch
{  public static void main(String[]args)
   {  try{
         Sysout("Main Method");
         Alpha1 a = new Alpha();
         a.alpha(); }
      Catch (ArithmeticException e)
      {  Sysout("Exception handled in main"); }
}
```

Output : Main method
Connection established
Enter first number 100
Enter Second number, 0
Exception handled in Alpha
Connection is terminated.
Exception handled in main

	throw	throws
*	Written inside method, usually in Catch block	Written in method signature
*	It is used to rethrow an exception	It is used to duck an exceptions.
*	Statements below the throw keyword are not executed	Statements below the 'throws' keyword are executed in the method.

Catch :→ if there is no exception, block will not execute
→ Only execute if there is a matching exception.

finally : finally block statements are executed if there are exceptions, no exception, throw keyword, hidden stmts.

Purpose of :
try and catch → to handle exception
throws → duck and method signature
throw → Catch → rethrow
finally → Close resource

The Exception Object Contains : 1. Name of the exception
2. Description of the exception
3. Stack trace of the exception

Methods to print exception informations:

1. getMessage() : prints the description of the exception
   Example : / by zero

2. toString() : prints the name and description of exception
   Example : ArithmeticException : / by zero

3. printStackTrace() : prints the name and the description of the exception along with stack trace.
   Example : ArithmeticException : / by zero at Demo.alpha();

Example

```
Class Demo
{  int disp()
   {  try
      {  Sysout("Method Started");
         return 10; }  // finally block cannot be written without try block, and should be at bottom only.
      finally
      {  Sysout("Method Ending"); }
   }                    // finally block will be executed even after return statement (finally will dominate "return").
public class Launch{
   public static void main(String[] args)
{  Demo d = new Demo();
      d.disp(); }
}
```

Output: Method Started
Method Ending.

Note: System.exit(0) will dominate finally and return statement. In above example replacing 'return' with System.exit(0) then the program will stop after the first statement and the program is terminated, no more running.

Code Snippets

1.
```
class Atom
{  Atom() { Sysout("atom"); } }

class Rock extends Atom
{ Rock (String type) { Sysout(type); } }

public class Mountain extends Rock {
      Mountain(){
                  super ("granite");
                  new Rock ("granite"); }
  }
  public static void main (String[]a) {new Mountain();}
}
```
Output: atom granite atom granite

2.
```
interface TestA { String toString(); }
public class Test{
  public static void main (String [] args)
{  Sysout (new TestA() { public String toString()
                          { return "test"; } }
}   }
```

3.
```
class Building{ }
public class Barn extends Building{
  public static void main (String [] args)
{ Building b1 = new Building(); Barn br1 = new Barn();
  Barn br2 = (Barn) b1; Object ob1 = (Object) b1;
  String str1 = (String) b1; Building b2 = (Building) barn; }
}
```
↳ RE: ClassCastException (this should be removed to compile).

4. interface Foo { }
Class Alpha implements Foo { }
Class Beta extends Alpha { }
Class Delta extends Beta
{ public static void main (String [] args) {
Beta x = new Beta();
16. // insert code here! }
} What line should be inserted to get ClassCastException?
Ans: Foo f = (Delta) x;

5. public class Batman { int squares = 81;
public static void main (String [] args) { new Batman().go(); }
void go() {
incr (++squares); System.out.println(squares); }
void incr (int squares) { squares += 10; }
} Output: 82

6 Class Pass { public static void main (String [] args)
{ int x = 5; Pass p = new Pass();
p.doStuff(x); System.out.println("main x = " + x); }
void doStuff (int x)
{ System.out.println("doStuff x" + x); } Output: doStuff x = 5
main x = 5

7. String [] elements = {"for", "tea", "too"};
String first = (elements.length > 0) ? elements [0] : null;

8. Class Foo { public int a = 3; // instance variables
public void addFive() { a += 5; System.out.println("f"); }
} Class Bar extends Foo { public int a = 8;
public void addFive() { this.a += 5; System.out.println("b"); }
}

Exception Handling in Java

```
try{
    Statement 1;
    Statement 2;
    Statement 3;
    try{
        Statement 4;
        Statement 5;
        Statement 6; }

    Catch (xxx e)
    { Statement 7; }

    finally { Statement 8; }

    Statement 9;
    }

Catch (YYY e)
  { Statement 10; }

finally { Statement 11; }

}
  Statement 12;
```

Case 1: If no exception occurs
Statements 1,2,3,4,5,6,8,9,11,12 will be executed.

Case 2: If exception occurs at Stmt 2 and corresp. Catch block is matched
Statements 1,10,11,12 will be executed

Case 3: If exception occurs at Stmt. 2 and corresponding catch block is not matched.
Statements 1,11 will be executed resulting to abnormal termination.

Case 4: If exception occurs at 5, and corresponding inner block is matched.
Statements 1,2,3,4,7,8,9,11,12 will be executed (normal)

Case 5: Exception at 5, and inner block not matched but outer Catch block matched
Statements 1,2,3,4,8,10,11,12 will be executed (normal)

Case 6: Exception at 5, and both catch blocks not matched.
Statements 8,4,1,2,3,11 will be executed (abnormal termination)

Valid Syntax in Exception Handling

1. Only try

```
try{...}
```
Not Allowed

2. Only Catch

```
Catch(xxxe)
{...}
```
Not allowed

3. Only finally

```
finally{...}
```
Not allowed

4. try-catch

```
try{..}
Catch (xxx e)
{...}
```
Allowed

5. Reverse order

```
Catch (xxx e)
{.....}
try{
   }
```
Not allowed.

6. Multiple try.

```
try{...}
try{...}
Catch (xxxe)
  {...}
```
Not valid

7. Multiple try and catch.

```
try{...}
Catch (xxxe)
{...}
```

```
try{...}
Catch (xxxe)
{...}
```
Valid

8. Multiple try

```
try{...}
Catch (xxxe)
{...}
 try{...}
```

Not allowed

9. Multiple Catch

```
try{...}
Catch (xxx e){...}
Catch (YYY e){...}
```

Allowed

10. Multiple Catch

```
try{...}
Catch (xxx e){...}
catch (xxx e){...}
```

Not allowed

11. Multiple Catch

```
try{...}
Catch (xxx | YYY e){...}
```

Allowed

12. try-finally

```
try{...}
finally{...}
```

Allowed

13. Catch-finally

```
Catch (xxx e)
 {...}
finally{...}
```

Not allowed

14. Unordered

```
try{...}
finally{...}
Catch (xxx e){...}
```

Not allowed

15. try - multiple catch - finally

```
try{...}
Catch (xxxe){...}
Catch (YYY e){...}
finally{...}
```

Allowed

16. Multiple finally

```
try{...}
Catch (xxx e){...}
finally{...}
finally{...}
```

Not allowed

17. Statements in between try - catch - finally

```
try{..}
Sysout (" ");
Catch (YYY e){...}
Sysout (" ");
finally{...}
```

Not allowed

18. Only try with resource

```
try(R)
{...}
```

Allowed

Synchronous Exceptions :- occurs at Specific program statement.

```
Class Launch
{ public Static void main (String[]args)
  { String Str= null;
    Str.toUpperCase();
  }
}
```

↳ NullPointerException.

Asynchronous Exceptions : occurs anywhere in the program.

```
public static void main(String[] args)
{
    Scanner scan = new Scanner (System.in);
     Sysout (" Enter name");
     String name = scan.next();
     Sysout (" Enter your grades");
     String grade = scan.next(); }
```

Output : Enter your name : Sachin
Enter your grades : CTRL + C (Keyboard interrupt)
Exception in thread "main" Terminate Batch Job (Y/N)?

User Defined Exception

Code

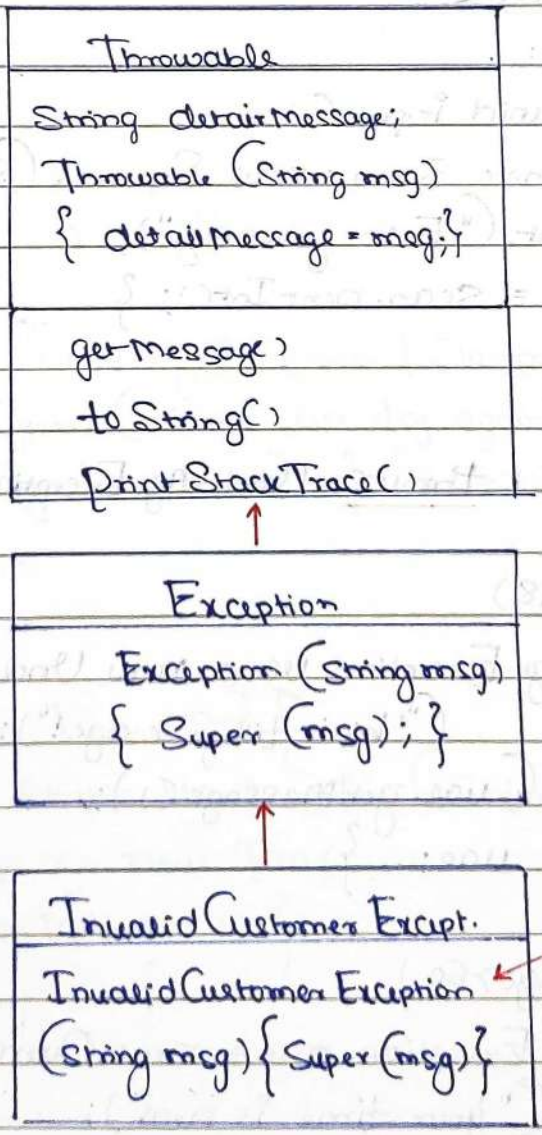
```
import java.util.Scanner;

Class InvalidCustomerException extends Exception // User defined
{   public InvalidCustomerException (String msg)    exception
        {  super (msg); }
}

Class Atm
{   int userId = 1212;    // data for verification
    int password = 1111;
    int pw; int uid;
    public void input()
    {   Scanner scan = new Scanner (System.in);
        Sysout (" Kindly enter user id");
        uid = scan.nextInt();
```

```
        Sysout (" Enter the password");
        pw = Scan.nextInt(); }

  Public void verify() throws InvalidCustomerException
{   if (Cuserid = uid) && (password == pw))
      {
        Sysout ("Take your cash"); }
    else
{   InvalidCustomerException ice = new InvalidCustomer
        Exception ("Are you sure"?); // passing args to
      Sysout (ice.getMessage());      Constructor
        throw ice; } // re throwing
  }                                   exception
}

Class Bank
{   public void initiate()
    {   Atm a = new Atm();
      try{
          a.input();
          a.verify(); }
Catch (InvalidCustomerException e1) // first catch block
{
  try{ a.input(); // re enter the data for verification
       a.verify(); }

  Catch (InvalidCustomerException e2)
{   try{                          // second catch block
        a.input();                re-confirming
        a.verify(); }
                                  // final time verification
```

```
Catch (InvalidCustomerException e3)   // final catch block
{  Sysout ("We caught you! Card is blocked");
   System.exit (0); } // terminates the program.
    }
  }  }
}.
```

```
Public class LaunchCE
{  public static void main (String [] args)
     {
        Bank b = new Bank();
        b.initiate (); }
  }
```

detailMessage is used by these methods to print Exception info.



A simple RTO program to implement exception handling:

```
import java.util.Scanner;
class UnderAgeException extends Exception // User defined
{  public UnderAgeException (String msg)   Class 1
      { super (msg); }
}

class OverageException extends Exception // User defined
{ public OverageException (String msg)   Class 2
      { super (msg); }
}

Class Applicant
{  int age;
   public void input()
   {  Scanner Scan = new Scanner (System.in);
      Sysout ("Enter your age");
        age = scan.nextInt(); }
}

void verify() throws UnderAgeException, OverageException
{
  if (age<18)
  { UnderAgeException uae = new UnderAgeException
                ("Wait till your age!");
     Sysout (uae.getMessage());
     throw uae; }

  else if (age>60)
  { OverageException oae = new OverageException
                ("your time is near");
```

```
        Sysout (oae.getmessage());
        throw oae; }

    else { Sysout ("You are eligible"); }
    }
}

Class RTO
{   public void initiate()
    {   Applicant a = new Applicant();
        try{
            a.input();
            a.verify(); }

        Catch (UnderAgeException | OverageException e) // handles one
        {                                                 or other
            try{ a.input();
                 a.verify(); }

            Catch (UnderAgeException | OverageException e1)
            {   Sysout ("Don't ever try again");
                System.exit(0); } // terminates the program.
    } } }

Public Class LaunchRTO{
    public Static void main (String[] args)
    {   RTO r = new RTO();
        r.Initiate(); }
}
```

Date 25/2/23

JDK 1.7 version enhancements

1. try with resource
2. try with multicatch block

Until jdk 1.6, it is compulsory required to write finally block to close all the resources which are open as a part of try block.

```
eg:: BufferReader br = null;
     try{
         br = new BufferReader(new FileReader("abc.txt"));
       }
     Catch (IOException ie)
     {   ie.printStackTrace();}

     finally{
             try{ if(br!=null)
                     br.close();}
         Catch (IOException ie)
         { ie.printStackTrace();}
     }
```

Problems in this approach:

1. Compulsorily the programmer is required to close all opened resources which increases the complexity of the program.
2. Compulsorily we should write finally block explicitely, which increases the length of the code and reduces readability.

To overcome this problem Sun MicroSystem introduced try with resources in "1.7" version of JDK.

- try with resources

In this approach, the resources which are opened as a part of try block will be closed automatically once the control reaches to the end of the code try block normally or abnormally, so it is not required to close explicitely and complexity of the program would be reduced.

It is not required to write finally block explicitly, so length of code would be reduced and readability is improved.

eg:: try (BufferReader br = new BufferReader (new FileReader ("abc.txt"))
{ // use br and perform the necessary operation
// once control reaches to the end of try block automatically br will be closed }

Catch (IOException ie)
{ //handling code }

Rules of using try with resource

1. We can declare any no. of resources, but all these resources should be seperated with ;
eg:: try (R1; R2; R3;){
// use the resource }

2. All resources are said to be AutoClosable resources if the class implements an interface called as "java.lang.AutoCloseable" either directly or indirectly.
eg:: java.io package classes, java.Sql. package classes.
public interface java.lang.AutoCloseable{
public abstract void close() throws java.lang.Exception ; }

Note: Which ever class has implemented this interface those class objects are referred as "resources".

3. All resource reference by default are treated as implicitly final and hence we can't perform assignment with in try block.

```
try (BufferReader br = new BufferReader (new FileWriter
                ("abc.txt"))
{   br = new BufferReader (new FileWriter ("abc.txt"));
}
```

Output:: CE Can't reassign a value.

4. Until 1.6 version try should compulsorily be followed by either catch or finally, but from 1.7 version we can take only "try with resources" without catch or finally.

```
try (R){
    //valid }
```

5. Advantage of try with resources concept is finally block will become dummy be cause it is not required to close resources explicitly.

6. try with resource nesting is also possible

```
try (R1){
    try (R2){
        try (R3){
        }
    }
}
```

Note: A code which should repeat multiple times in our project with small change or no change, such code we call it as "boilerplate" code

Multi Catch Block

Till jdk 1.6, eventhough we have multiple exception having same handling code we have to write a seperate catch block for every exception, it increases length of code and reduces readability.

```
eg:: try{ ...
      ...}
     Catch (ArithmeticException ae){
          ae.printStackTrace(); }
     Catch (NullPointerException ne){
          ne.printStackTrace(); }
```

To overcome this problem SUN MS has introduced "multi catch block" concept in 1.7 version

```
eg:: try{ ...
      ...}
     Catch (ArithmeticException | NullPointerException ae)
       { e.printStackTrace(); }

     Catch (ClassCastException | IOException e)
       { e.printStackTrace(); }
```

In multi catch block, there should not be any relation b/w exception types (either child to parent or parent to child or same type) it would result in compile time error.

```
eg:: try{.. }
     Catch (ArithmeticException | ExceptionOne ){
          e.printStackTrace(); }
```

Output: CE

Rules of overriding when exception is involved.

While overriding if the child class method throws any checked exception compulsorily the parent class method should throw the same checked exception or its parent otherwise we will get compile time error.
There are no restrictions on Unchecked Exceptions.

eg::

```
class Parent { public void m1(); }
class Child extends Parent
{ public void m1() throws Exception { } }
```

error: m1() in Child cannot override m1() in Parent
public void m1() throws Exception { }
overridden methods does not throw Exception.

Rules w.r.t Overriding

1. Parent: public void m1() throws Exception { }
   Child: public void m1()
   valid

2. Parent: public void m1() { }
   Child: public void m1() throws Exception { }
   invalid

3. Parent: public void m1() throws Exception { }
   Child: public void m1() throws Exception { }
   valid

4. Parent: public void m1() throws IOException { }
   Child: public void m1() throws IOException { } valid

5. Parent: public void m1() throws IOException { }
Child: public void m1() throws FileNotFoundException, EOFException { } Valid

6. Parent: public void m1() throws IOException { }
Child: public void m1() throws FileNotFoundException, InterruptedException { } invalid

7. Parent: public void m1()
Child: public void m1() throws ArithmeticException, NullPointerException, RuntimeException { } Valid

8. Parent: public void m1() throws IOException
Child: public void m1() throws Exception { } invalid

9. Parent: public void m1() throws Throwable { }
Child: public void m1() throws IOException { } Valid

* instanceof: We can use the instanceof operator to check weather the given an object is particular type or not

eg:: r instanceof X
(reference, Class/interface name)

```
eg:: ArrayList al = new ArrayList(); // inbuilt object where we can keep any type of other objects
     al.add(new Student());  // 0th position
     al.add(new Cricketer()); // 1st position
     al.add(new Customer()); // 2nd position
     Object o = l.get(0); // l is an arraylist object.
     if (o instanceof Student) { Student s=(Student)o;
                                 // perform Student Specific opn. }
```

```
elseif (o instanceof Customer){
    Customer c = (Customer)o;
    // perform customer specific operations }
```

```
eg:: Thread t = new Thread();
     Sysout (t instanceof Thread); // true
     Sysout (t instanceof Object); // true
     Sysout (t instanceof Runnable); // true
```

```
eg::
    Public class Thread extends Object implements
                Runnable {    }
```

* To use instanceof operator compulsoraly there should be some relation between argument types (either child to parent or parent to child or same type) Otherwise we will get Compile time error saying inconvertable types.

```
eg:: String s = new String("Sachin");
     Sysout (s instanceof Thread); // CE
```

* Whenever we are checking the parent object is child type or not by using instanceof operator that we get false.

```
Object o = new Object();
Sysout (o instanceof String); // false
Object o = new String("ashok");
Sysout (o instanceof String); // true
```

* for any class or interface X null instanceof X is always returns false Sysout (null instanceof X); // false

eg:: Object t = new Thread();
Sysout (t instanceof Object); // true
Sysout (t instanceof Thread); // true
Sysout (t instanceof Runnable); // true
Sysout (t instanceof String); // false
Sysout (null instanceof Object); // false

* isInstance() : The isInstance() method is used to check if the specified object is compatible to be assigned to the instance of this class.

Difference between instanceof and isInstance():

instanceof :
* instanceof an operator which can be used to check weather the given object is a particular type or not.
* eg:: String s = new String("sachin");
Sysout (s instanceof Object); // true

isInstance():
* isInstance() is a method, present in class "Class", we can use it to check weather the given object is particular type or not. We don't know the type at the beginning, it is available dynamically at runtime.
* eg:: class Test{
public static void main (String[] args)
{ Test t = new Test();

Sysout (Class.forName (args[0]).isInstance(t)); }

}

java Test Test // true
java Test String // false

Code Snippets

1.
```
interface Foo{ }
Class Alpha implements Foo{ }
Class Beta extends Alpha{ }
Class Delta extends Beta{
  Public Static void main(String [] args)
{  Beta x = new Beta();
     // insert code here }
}
```

What code will cause java.lang.ClassCastException?
Foo f = (Delta) x; (Because foo is not related to delta).

2.
```
Public Class Batman{
  int Squares = 81;
 Public Static void main (String[] args)
  { new Batman().go(); }
 void go(){
        incr (++Squares);
        Sysout (Squares); }
 void incr (int squares) { squares += 10; }
}
```

Output: 82

3.
```
public Class Pass{
  Public Static void main (String[] args)
{  int x = 5;
   Pass p = new Pass();
     p.doStuff(x); Sysout("main x" + x); }
 void doStuff (int x)                    // main x = 5
{  Sysout ("doStuff x = " + x++); } // doStuff x = 5.
```

4. Class Thingy { Meter m = new Meter(); }
Class Component { void go() { Sysout("C"); } }
Class Meter extends Component { void go() { Sysout("m"); } }
Class DeluxThingy extends Thingy {
Public Static void main (String[] args)
{ DeluxThingy dt = new DeluxThingy();
dt.m.go();
Thingy t = new DeluxThingy();
t.m.go(); }
}

Output: mm

5. public Static void main (Strings[] args)
{ Integer i = new Integer(1) + new Integer(2);
Switch (i) {
Case 3: Sysout("three"); break;
default: Sysout("other"); break; }
}

Output: ~~three~~

6. Class Mammal { }
Class Racoon extends Mammal { // Racoon "IS-A" mammal ✓
Mammal m = new Mammal(); } Racoon HAS-A mammal ✓
Class BabyRacoon extends Mammal { }
// BabyRacoon 'IS-A' mammal ✓, BabyRacoon 'HAS-A' mammal ✗
does not have.

7.

```
Public Class Hello
{ String title;
  int value;
public Hello()
{ title += "World"; }
```

```
public Hello(int value)
{ this.value = value;
  this = "Hello";
  Hello(); }
```

```
Hello c = new Hello(5);
Sysout(c.title);
```

↓ Constructor can't be called explicitely
Compile Time Error.