"Mastering Java Development: From Scratch to Pro"

Our Coding School YouTube Guided By Mr. Ved Prakash Java

IN THIS COURSE, WE COVER THE SYLLABUS.

1. Basics Java

- Definition
- JVM
- JIT
- Syntax
- Variables
- Operators
- Control flow statement
- Looping statement
- Number systems
- Pattern program

2. CORE JAVA

- Code execution process in method
- Class and Interfaces
- Constructor and constructor chaining
- OOPS(Object Oriented Programing Language)
  - Polymorphism
  - Inheritance
  - Encapsulation
  - Abstraction
- Generalization and specialization
- Strings
- Arrays

3. Java Library

- ➢Packages
- ➢Wrapper class
- ➢Exceptions and Exception handling
- ➢User define exception
- ➢Collections (List, Queue, Set)
- ➢Map(HashMap, LikedHashMap, TreeMap)
- ➢Threads, Multithreading and threads life cycle
- ➢I/O Streams
- ➢ been / pojo class
- ➢File handling (creating, reading, writing)
- ➢Lambda expression
- ➢Serialization
- ➢Garbage collector

4. Advance Java

- ➢ JDBC (Java Data Base Connectivity)

5. Frame work

- ➢ Spring
- ➢ Spring data jpa
- ➢ Hibernate
- ➢ Spring MVC
- ➢ Spring Boot
- ➢ Microservices basics

Required Tools:

- **For Basic and Core Java:**
  - Edit Plus for beginners
  - Eclipse IDE
  - JDK 17 or JDK 1.8
- **For Advanced Java:**
  - MySQL or SQL Database
- **For Frameworks:**
  - Gradle or Maven

Eclipse :

- Latest eclipse download from official website link is given below,
  https://www.eclipse.org/downloads/download.php?file=/oomph/epp/2024-09/R/eclipse-inst-jre-win64.exe
- Extract the jar
- Open eclipse
- Go to eclipse installer
- If you are going to develop only stand alone application then click on Eclips ide for java development.
  If you are going to develop stand alone along with Enter prises addition application then click on Eclips ide for java development.
- Select the jdk path: make sure jdk 17 or 1.8 is installed
  - go to c drive,
  - then go program file,
  - Then go to java
  - Then select the jdk 17 or 1.8
- Guide Link is shown below
  https://geekyscript.com/how-to-install-eclipse-ide-in-windows-10-step-by-step-complete-guide/

JDK 17 Downloading process:

- **Download:** Visit the official Oracle JDK 17 download page and select the Windows installer.
- **Run Installer:** After downloading the .exe file, run the installer and follow the on-screen instructions.

Set Environment Variables:

Click on "Environment Variables" :

- Under System variables, click "New" to add.
- JAVA_HOME = path to your JDK (e.g., C:\Program Files\Java\jdk-17).
- Path = add %JAVA_HOME%\bin to the existing values.

Verify: Open Command Prompt and type java -version to check if it's installed correctly.

Course : Java
Part : Basic Java

Java Definition :

- Java is a high-level programming language used to represent or correlate real-world entities.
- Java was developed by Sun Microsystems, with James Gosling as the lead developer, in 1995.

Program :

Program is a set of instruction which is use to perform specific operation.

Programing language:

The langue which is use to create a set of instruction.

Type of Language:

- **Low level Language :** which is understandable by machine. (Exa Binary code)
- **Middle level Language :** Which is minimum understand by human.(Exa byte code)
- **High level Language :** Which is understandable by human.(Exa java, Paython, C++, C#, C)

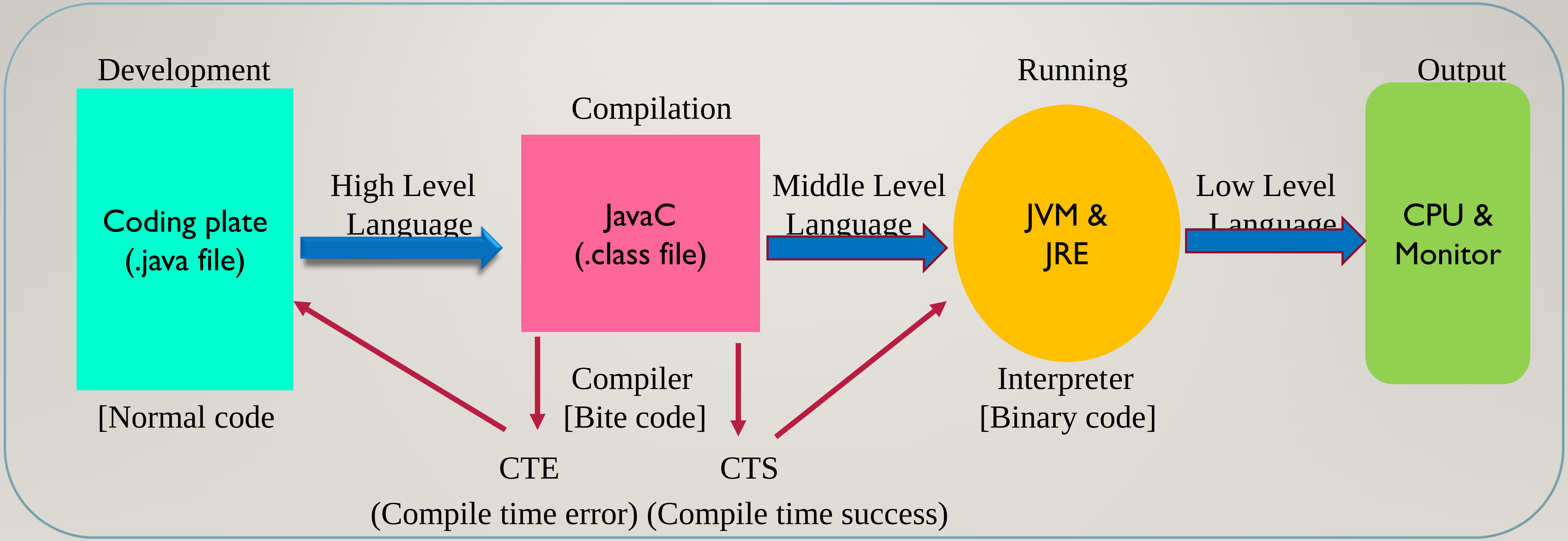
Steps :

- A developer writes the code and saves it as a Java file, which is in a high-level language.
- Then, the file is sent for compilation, where it may result in either a compilation error or success.
- If the compilation is successful, the code is converted into bytecode.
- The bytecode is then executed by the JVM **(Java Virtual Machine),**
- which converts it into binary code. Finally, the result is displayed on the monitor.

Types of file in java :

- **.java file :** high level programing language which is created by developer as a java file with .java extension.
- **.class file :** middle level programing language which is created by compiler as class file with .class extension.

Process of Execution in java:



Java Features:

1.**Platform Independence:** Write Once, Run Anywhere" (WORA) via JVM.

2.**Object-Oriented:** Supports OOP principles: Encapsulation, Inheritance, Polymorphism, Abstraction.

3.**Robust:** Strong memory management, exception handling, and garbage collection.

4.**Secure:** Built-in security features (e.g., security manager, bytecode verification).

5.**Multi-threading :** Supports concurrent execution of multiple threads for better performance.

6.**High Performance:** JIT compiler improves execution speed.

7.**Dynamic:** Can load classes dynamically and supports reflection.

8.**Rich Standard Library:** Extensive APIs for data structures, I/O, networking, and GUIs.

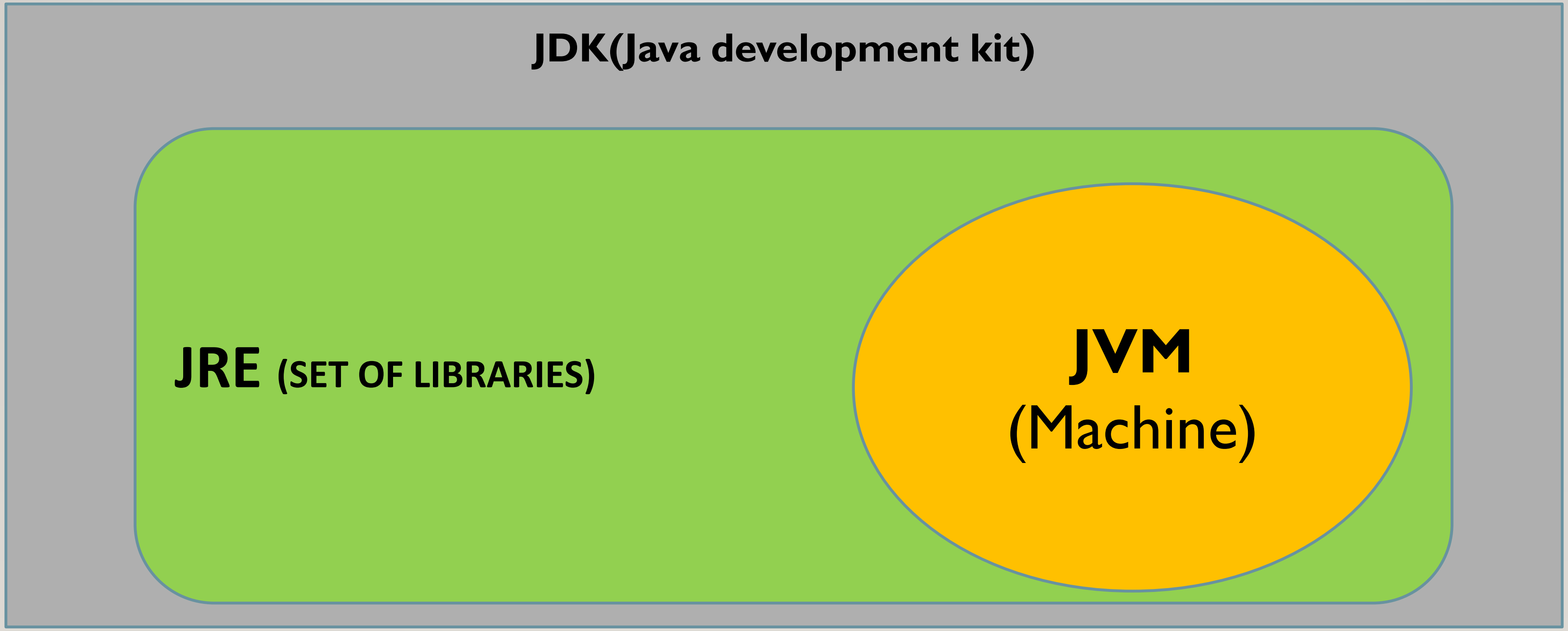
9.**Automatic Memory Management:** Garbage collection eliminates memory management issues.

11.**High-Level Language:** Abstracts low-level details, making development easier.

12.**Scalability:** Suitable for both small and large-scale applications.

JVM (Java virtual machine) & JRE (Java run time environment):-

It is responsible for execution, it convert the byte code into a binary code. this is send to a machine to display the output.



Syntax:-

```
Class ClassName{
Public static void main(String[] arge){
code
}
}
```

Camel Case:

A naming convention where the first letter of the first word is lowercase, and the first letter of each subsequent word is uppercase (e.g., myVariableName), method and variable name follow camel case.

Pascal Case:

A naming convention where the first letter of each word is uppercase (e.g., MyVariableName), Class and Constructor name follow pascal case.

Data Type :-

Data type is use to create a memory, it is also use to specify size of memory.

Type:-

Primitive Datatype :

data type having size is called primitive data type.

1. **Boolean :** we are defining with true and false.

   Exa : boolean a=true;

2. **Character :** any special and single alpha bate consider as a character, define by char in side single cod (‘’).

   Exa : char a=‘x’ or ‘%’ or ‘1’;

1. **Number :** byte : it is hole number, declare by byte and it is smallest number in size(1byte)

   Exa : byte a=100; this is max size (max 3 digit)

- **short :** it is hole number, declare by short and it is grater then byte.(2byte)

  Exa : **short** c=10000; (max 5 digit)

- **int :** it is hole number, declare by int and it is less then 10 digit.(4byte)

  Exa : **int** d=1000000000; (max 10 digit)

- **long :** it is hole number, declare by long,L or l should mentioned at the last.(8byte)

  Exa : **long** a=1000000000000000000L; (max 19 digit)

4. **Float :**

- **float:** use to store decimal value, having smal size, mention at the F or f. (4byte)

  Exa : `float f=100000000000000000000000000000000000000.0F; (39 digit max)`

- **double :** use to store decimal value, having large size. (8byte)

  Exa : `double f=10.0F;`

Non-Primitive Datatype:- data type don't having side.

1. **String :** String is an immutable sequence(collection) of characters used to represent text. Writing in side double code ("").

   Exa : **String** a="a";

2. **Array** : array in Java is a collection of elements of the same type stored in a contiguous memory location.

   Exa : **int[]** numbers = {1, 2, 3, 4, 5};

2. **Collection** : A collection in Java is a framework that provides an architecture to store and group of objects.

   Exa : **List<String>** list = new ArrayList<>();

   list.**add**("Hello");

3. **Predefine data type :** it is an instance of a class provided by the Java standard library .

Variable :

it is a empty memory where we can store and declare the data.

Exa : **int number = 5, double d=5.0;**

Rule to declare variable : Syntax : datatype variableName=value;

1. Variable start with alpha bate and space not allowed (follow camel case)
2. Not allowed number and special character at the starting, at the starting accept (_ and $) and alpha bate only.

Scanner Class:

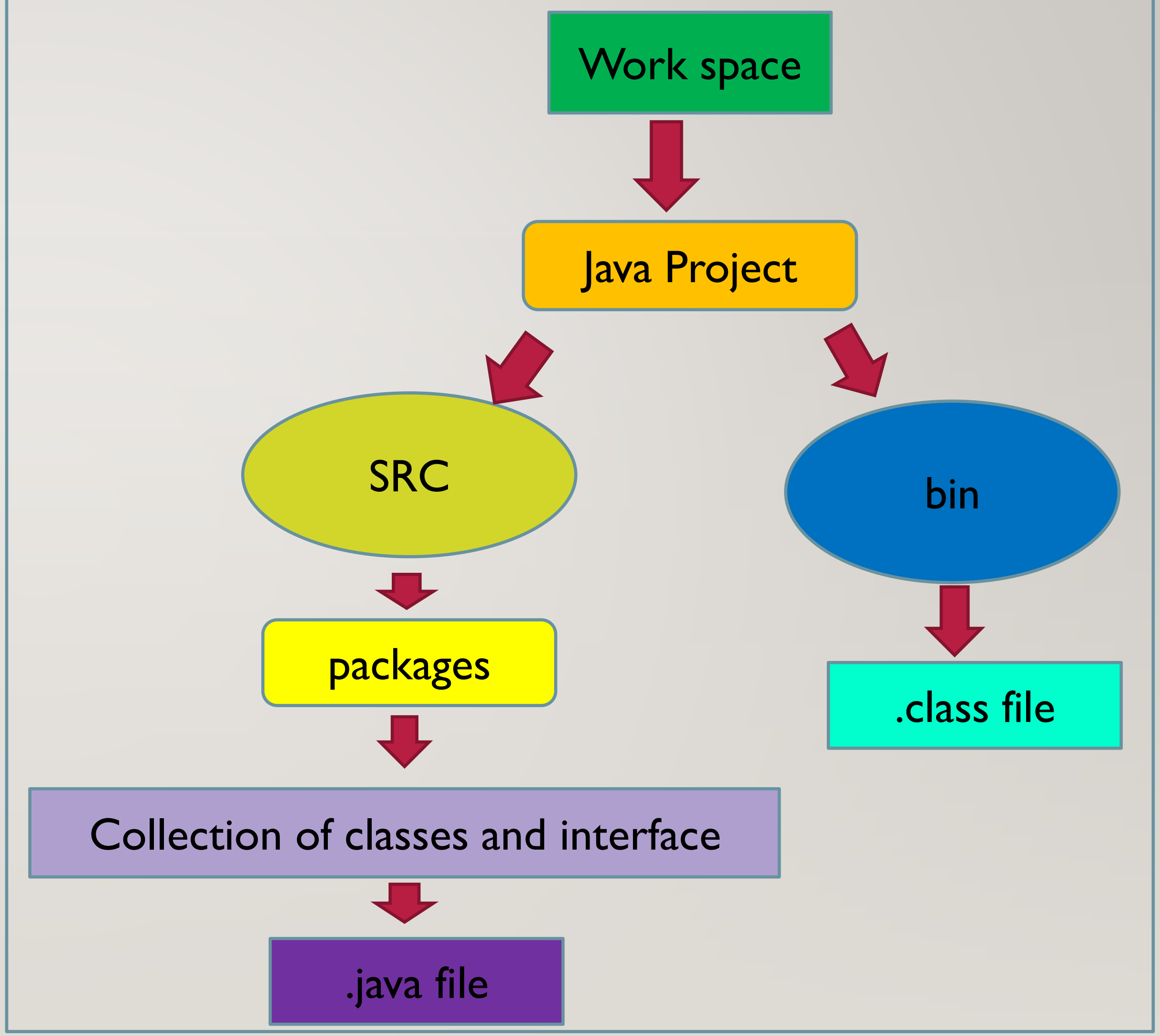
For taking run time input we use Scanner :

Scanner is use to take runtime input.

```
import java.util.Scanner;
public class ScannerExample {
    public static void main(String[] args) {
        Scanner scanner = new Scanner(System.in);
        System.out.print("Enter your name: ");
        String name = scanner.nextLine();
        System.out.print("Enter your age: ");
        int age = scanner.nextInt();
        char c=scanner.next().charAt(0);
        scanner.close();
    }}
```

Eclipse Hierarchy:

- **Workspace:** A workspace is a folder where we store files and data, One workspace can contain multiple Java projects.
- **Java Project:** A Java project is a container for creating Java applications, It is a directory that organizes source code and other project files.
- **SRC Folder:** The SRC folder within a Java project is where we create Java packages. A single SRC folder can contain multiple packages.
- **Packages:** Packages are used to organize classes and interfaces. Each Java file typically contains one or more classes or interfaces.
- **bin Folder:** The bin folder is used to store the compiled class (.class file) files that are automatically generated by the compiler.



Key words in java :

In Java, keywords are reserved words that have a predefined meaning, It is always small latter.

1. abstract
2. assert
3. boolean
4. break
5. byte
6. case
7. catch
8. char
9. class
10. const (not used)
11. continue
12. default
13. do
14. double
15. else
16. enum
17. extends
18. final
19. float
20. for
21. goto (not used)
22. if
23. implements
24. import
25. instanceof
26. int
27. interface
28. long
29. native
30. new
31. null
32. package
33. private
34. protected
35. public
36. return
37. short
38. static
39. strictfp
40. super
41. switch
42. synchronized
43. this
44. throw
45. throws
46. transient
47. try
48. void
49. volatile
50. while
51. var (added in Java 10 for local variable type inference)
53. record

identifier :

An identifier in Java is a name used to identify variables, methods, classes, or other entities, and it must start with a letter, underscore (_), or dollar sign ($), followed by any combination of letters, digits, underscores, or dollar signs. and which is not keyword.

Exa : **int myVariable = 5;**

Variable : variable is a memory block. Which has 4 property.

1. Variable Name
2. Variable Type
3. Variable Size
4. Variable Data

Re-initialization :- **variable_name= data;**

Data_type data_name = data;

Variable declaration **Variable initialization**

Variable initialization

- **byte** by=10;
- **short** so=100;
- **int** num=1;
- **long** lo=1000000L;
- **double** double=1.00;
- **float** float=1.00f;
- **char** char='@';
- String string="String";
- **boolean** bool=**true**;

Operator :

Operator is use to perform operation.

1. Arithmetic Operators

Used to perform basic arithmetic operations.

Type : + : Addition and concatenation > - : Subtraction > * : Multiplication > / : Division > % : Modulus (remainder)

Exa : int a = 10, b = 5;   int sum = a + b; // sum = 15 (add) > String sum = a + b; // sum = 105 (con) >
int diff = a - b; // diff = 5 > int prod = a * b; // prod = 50 int div = a / b; // div = 2 > int mod = a % b; // mod = 0

2. Relational Operators

Used to compare two values.

Type : == : Equal to / != : Not equal to / > : Greater than / < : Less than / >= : Greater than or equal to / <= : Less than or equal to

Exa : int x = 10, y = 10; > boolean result = x > y; // result = false > boolean result = x < y; // result = false >
boolean result = x <= y; // result = true > boolean result = x >= y; // result = true >
boolean result = x == y; // result = true > boolean result = x != y; // result = false >

3. Logical Operators

It used to perform logical operations on boolean values.

Type : && : Logical AND > || : Logical OR > ! : Logical NOT

Exa : boolean a = true, b = false; > boolean result = a && b; // result = false > boolean result = a || b; // result = true > boolean result = !b; // result = true

4. Assignment Operators

Used to assign values to variables.

Type : = : Simple assignment > += : Add and assign > -= : Subtract and assign > *= : Multiply and assign > /= : Divide and assign > %= : Modulus and assign

Exa : int x = 5;   > x += 3; // x = x + 3; x = 8 > x *= 2; // x = x * 2; x = 16

5. Unary Operators

Which can performed using single operator and single operant.

++ : Increment , - - : decrement

Int a=10;

- Pre Increment : first increased by 1 and update it.   Exa : ++a +a=20
- Post Increment : first update it and increased by 1.   Exa : (a++) +a=21
- Pre decrement : first decrees by 1 and update it.   Exa : - -a +a=20
- Post decrement : first update it and decrees by 1.   Exa : (a- -) +a=19

6. Binary Operators

Which can performed using single operator and double operant.

Exa : a=10,b=10;   a+b=20;

6. Ternary Operators
Which can performed using two or more then two operator and two or more then two portent.
Exa : a=10;   String result=(a==10) ? “Hello”:”Byee”;

7. Bitwise Operators
Used to perform bit-level operations on integer data.
Type : & : Bitwise AND / | : Bitwise OR / ^ : Bitwise XOR / ~ : Bitwise NOT / << : Left shift
>> : Right shift
Example : int a = 5, b = 3;   int result = a & b;

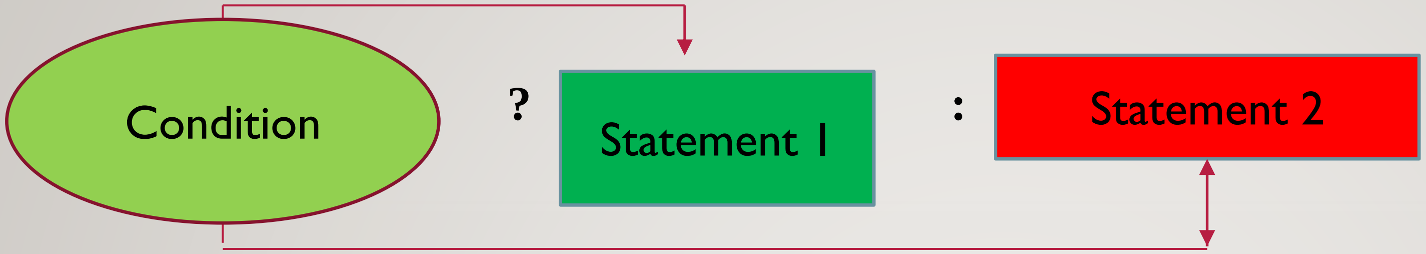
8. Instanceof Operator
Checks if an object is an instance of a specific class or interface.
instanceof : Checks type compatibility
Exa : String str = "Hello";   boolean isString = str instanceof String;

Ternary operator :

It is a one-liner conditional operator that takes three operands. It's used as a reduce the line of code, for if-else statements.

true

Syntax:



false

Exa : int a = 5, b = 10;

int min = (a < b) ? a : b; // min will be 5

Control Statement :

Which is use to control the flow of execution. Jvm always executed top to bottom and left to right.

Control Statement

- Selection Statement
  1. if
  2. if else
  3. else if
  4. nested if
  5. switch
- Looping Statement
  1. for loop
  2. nested for loop
  3. while loop
  4. do wile loop
- Jumping Statement
  1. break
  2. continue
  3. return

ASCII (American Standard Code for Information Interchange) :

ASCII value refers to the numerical representation of a character in the ASCII encoding standard, which maps characters like letters, digits, and symbols to integers (e.g., 'A' is 65, 'a' is 97).

Exa :	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90

a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v	w	x	y
97	98	99	100	101	102	103	104	105	106	107	108	109	110	111	112	113	114	115	116	117	118	119	120	121

z=122

INPUT1	**INPUT2**	**OUTPUT**	**OPERATION**
String String String String Bool	String Number Char Bool String	String String String String String	Concatenation Concatenation Concatenation Concatenation Concatenation
Number Number Character Character	Number character Number Character	Number Number Number Number	Summation ASCII ASCII ASCII

INPUT1	**INPUT2**	**OUTPUT**
Boolean	Boolean	Error
Boolean	Number	Error
Boolean	Character	Error
Number	Boolean	Error
Character	Boolean	Error

If condition :

if condition in Java checks whether a condition is true or false and executes code based on that. if true execute it.

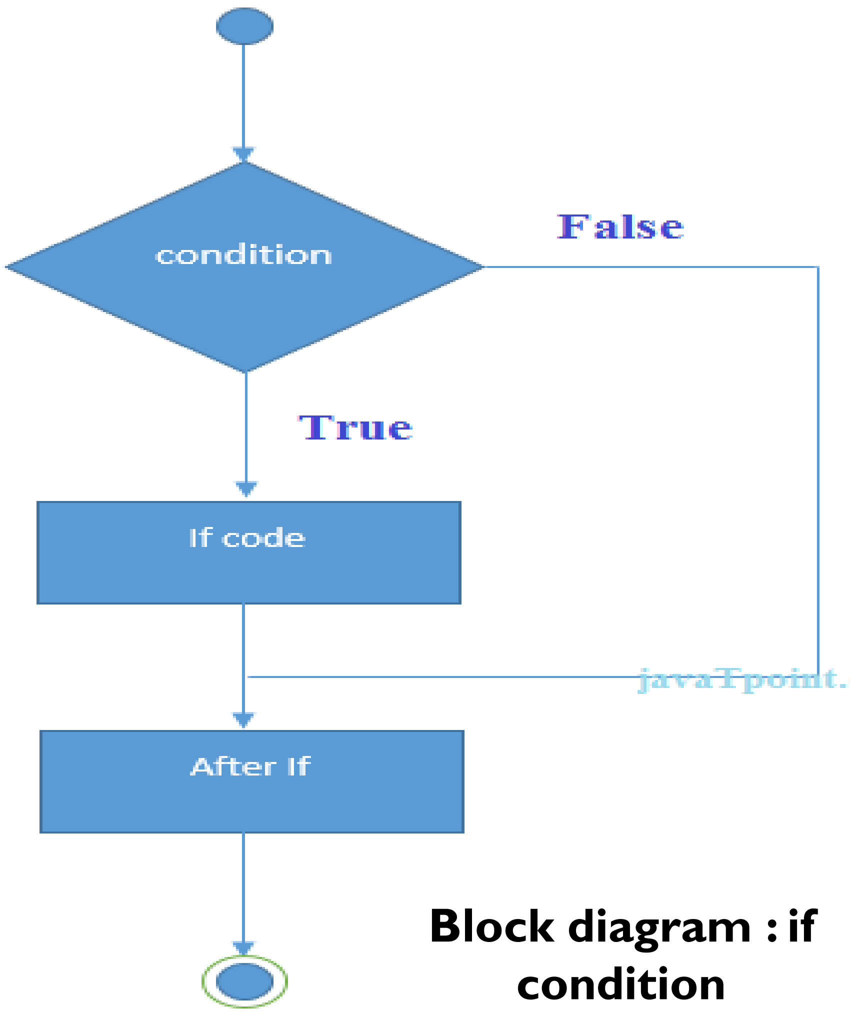
Exa :

```
int number = 10;
if (number > 5) {        //true
    System.out.println("Number is greater than 5");
}
```

*****or *****

```
if (number > 5)          //true
    System.out.println("Number is greater than 5");
```

Note : if we have single line logic then, we no need to use



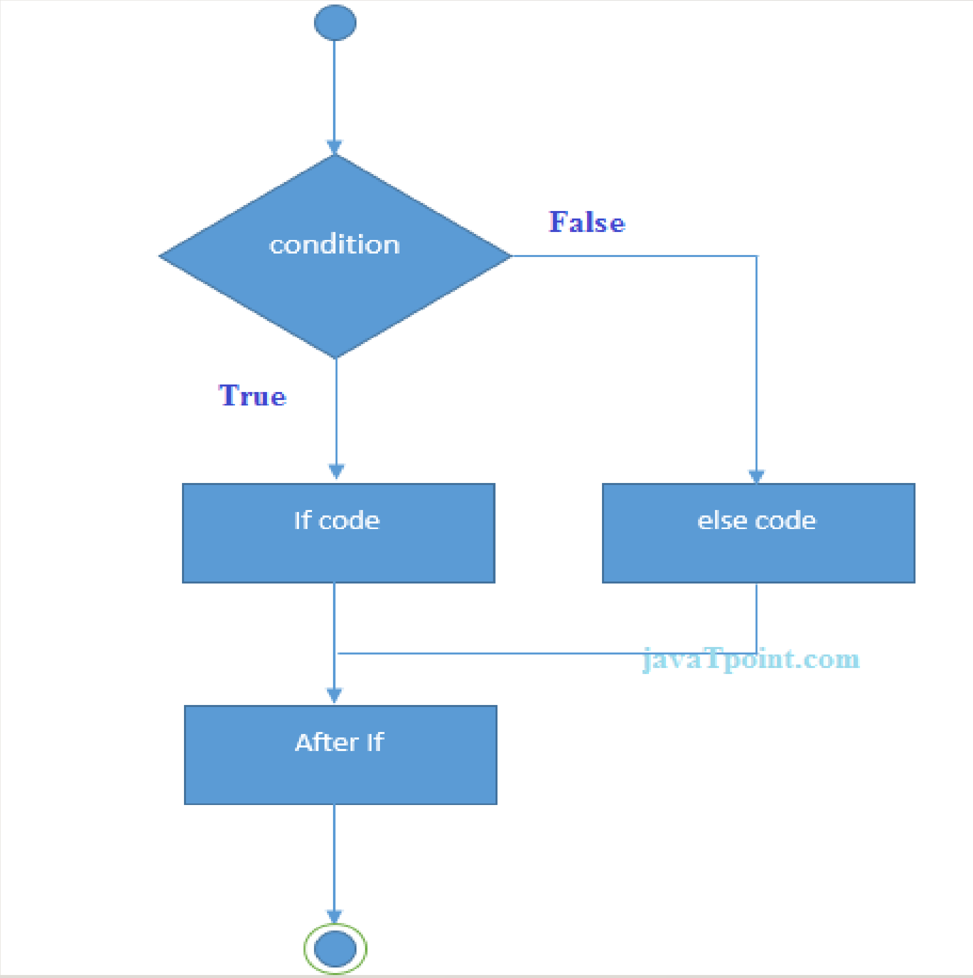
Block diagram : if condition

If else condition :

if-else condition is used to execute one block of code if a condition is true and if it is false then else will execute.

Exa :

```
int num = 5;
if (num > 0) {            //true
    System.out.println("Positive number");
} else {
    System.out.println("Non-positive number");
}
```



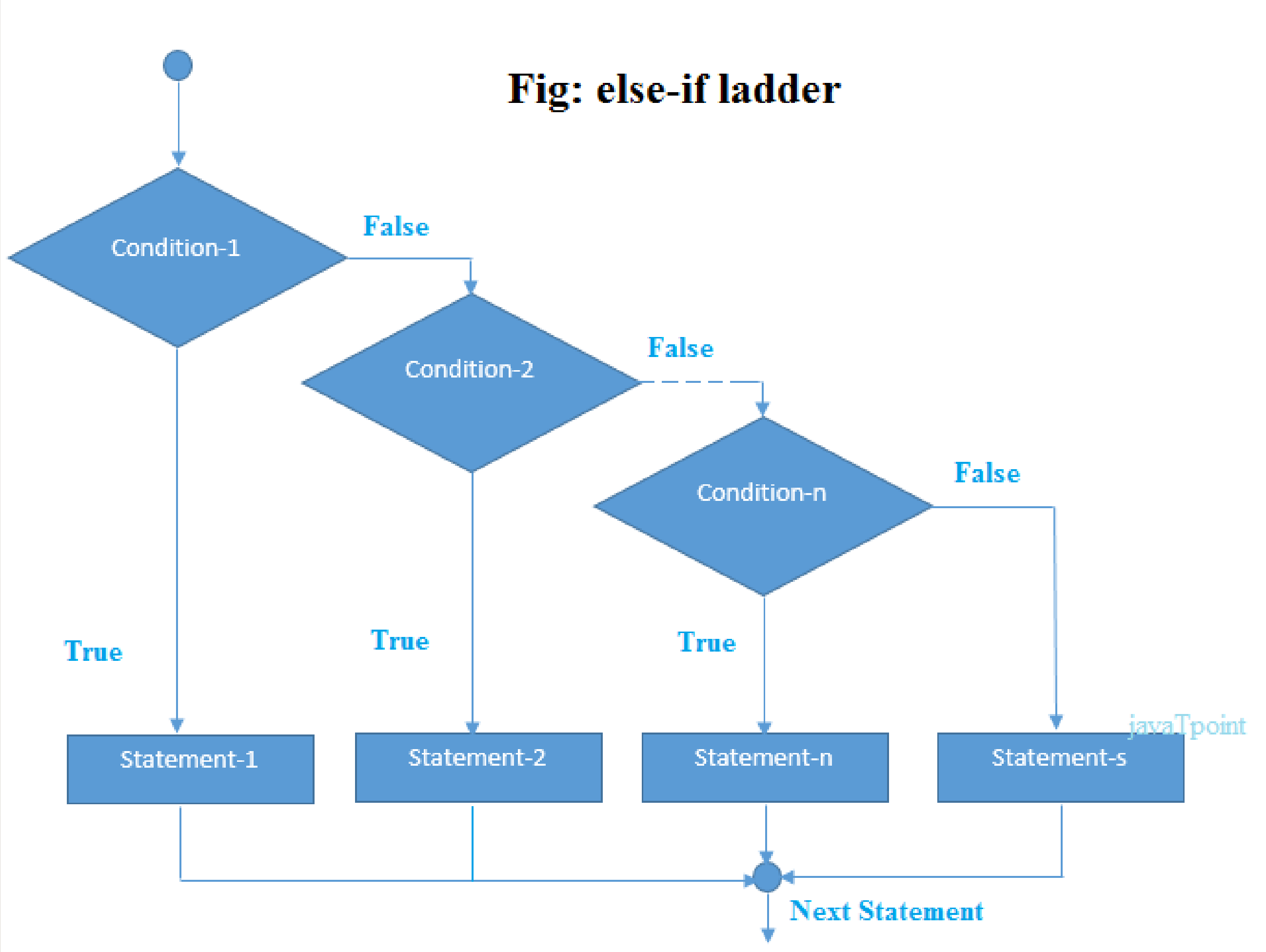
block diagram :- if else condition

else if condition :

else if condition is used to test multiple conditions in sequence.
If the first if condition is false, the program checks the next else if condition, till conation is matched if all condition unmatched then else block will be executed.

Exa :

```
int num = 10;
if (num > 15) {              //false
    System.out.println("Greater than 15");
} else if (num > 5) {    //true
    System.out.println("Greater than 5");
} else {
    System.out.println("5 or less");
}
```

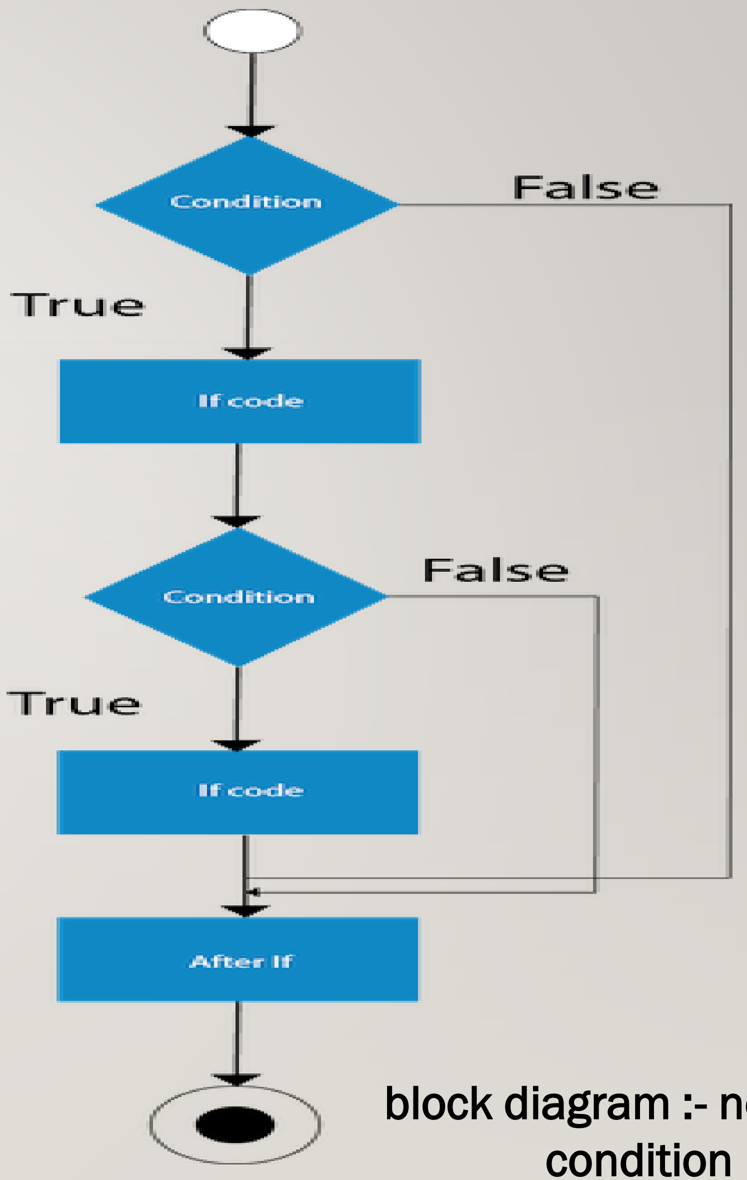


Nested if condition :

if statement placed inside another if statement. It allows for multi-level decision-making. if outer if will become true then only
it will go to inner if condition.

Exa :

```
int num = 10;
if (num > 5) {                  //true
    if (num < 15) {        //true
        System.out.println("Number is between 5 and 15");
    }
}
```



block diagram :- nested if condition

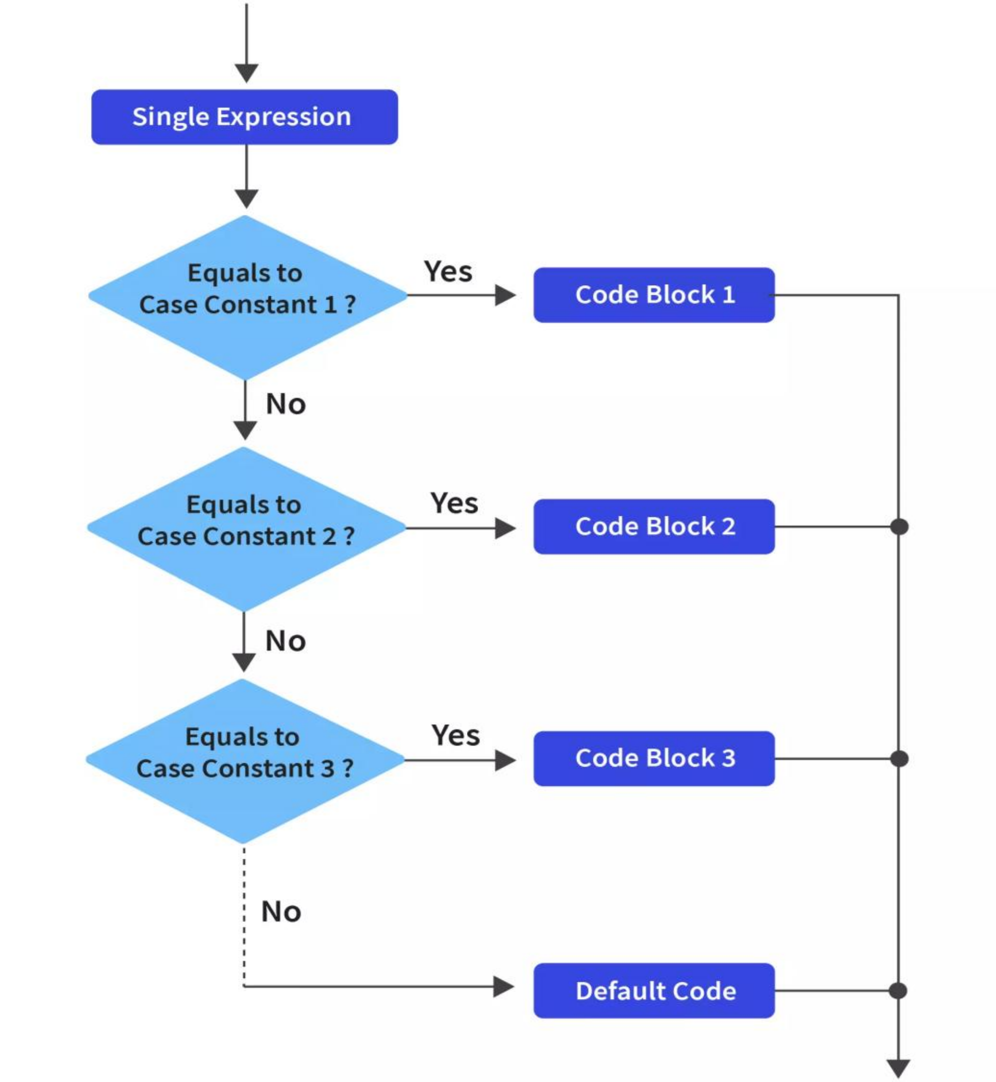
Switch case :

it is used to select one among multiple options based on the value of an expression.

Exa :

```
int day = 2;
switch (day) {
    case 1:
        System.out.println("Monday");
        break;
    case 2:
        System.out.println("Tuesday");
        break;
    default:
        System.out.println("Other day");
}
```

Output : Tuesday



block diagram :- Switch case

For loop :

it is used to execute the block of code a specific number of times.

Exa :

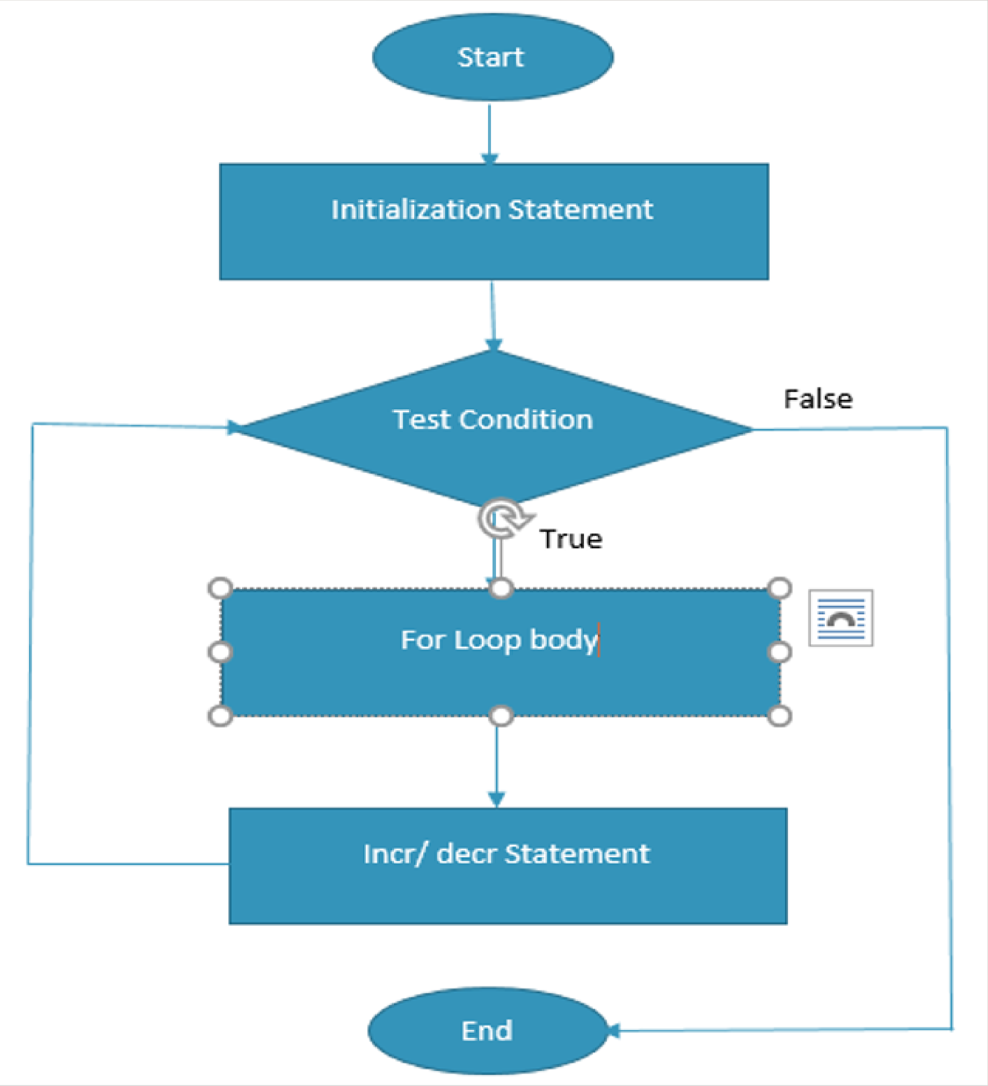
```
for (initialization; condition; update) {
// Code
}
public class Test {
public static void main(String[] args) {
for (int i = 1; i <= 5; i++) {
System.out.print(i);
System.out.println(i);
}
}
}
```

o/p - 1 2 3 4 5

12345

Note : System.out.println(i);

this ln will print on next line.



block diagram :- for loop

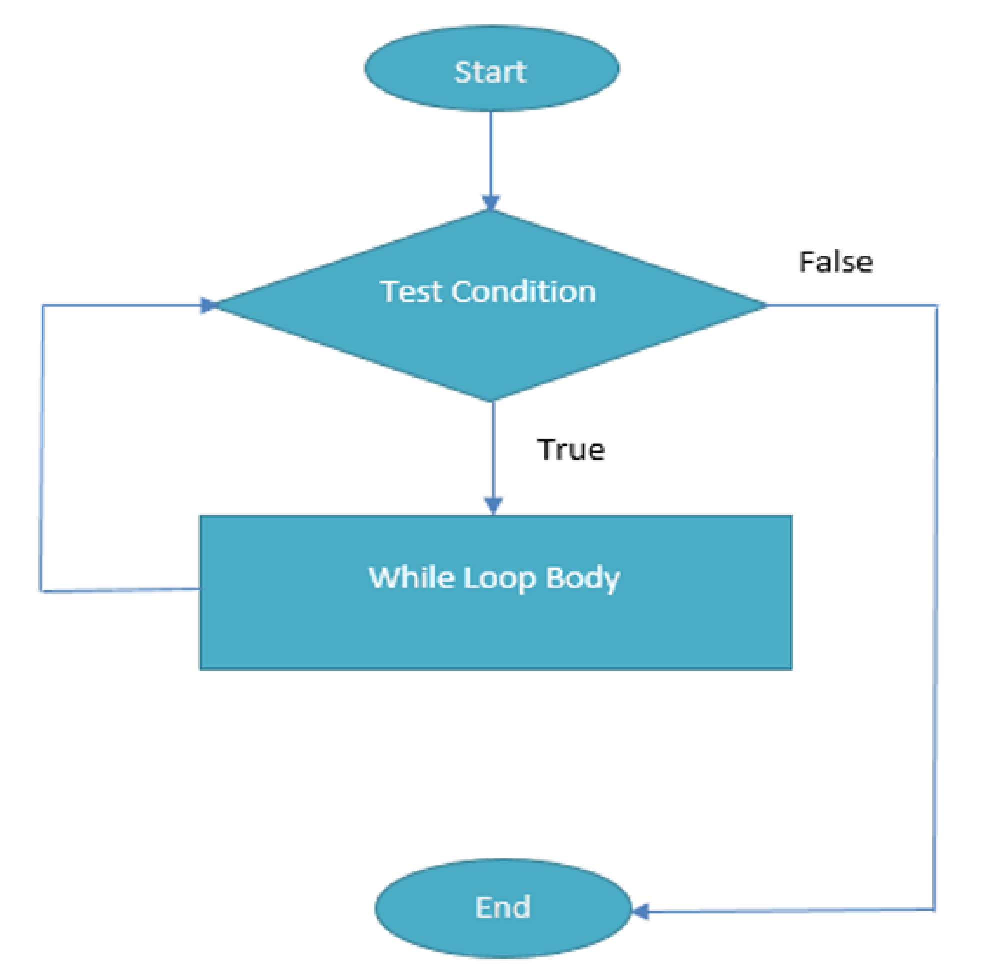
While loop :

it is repeatedly executes a block of code as long as the specified condition is true.

Exa :

```
while (condition) { // Code
Update;
 }
public class Test {
public static void main(String[] args) {
int i = 1;
while (i <= 5) {
System.out.println(i);
i++;
}
}}
```

o/p - 1 2 3 4 5



block diagram :- while loop

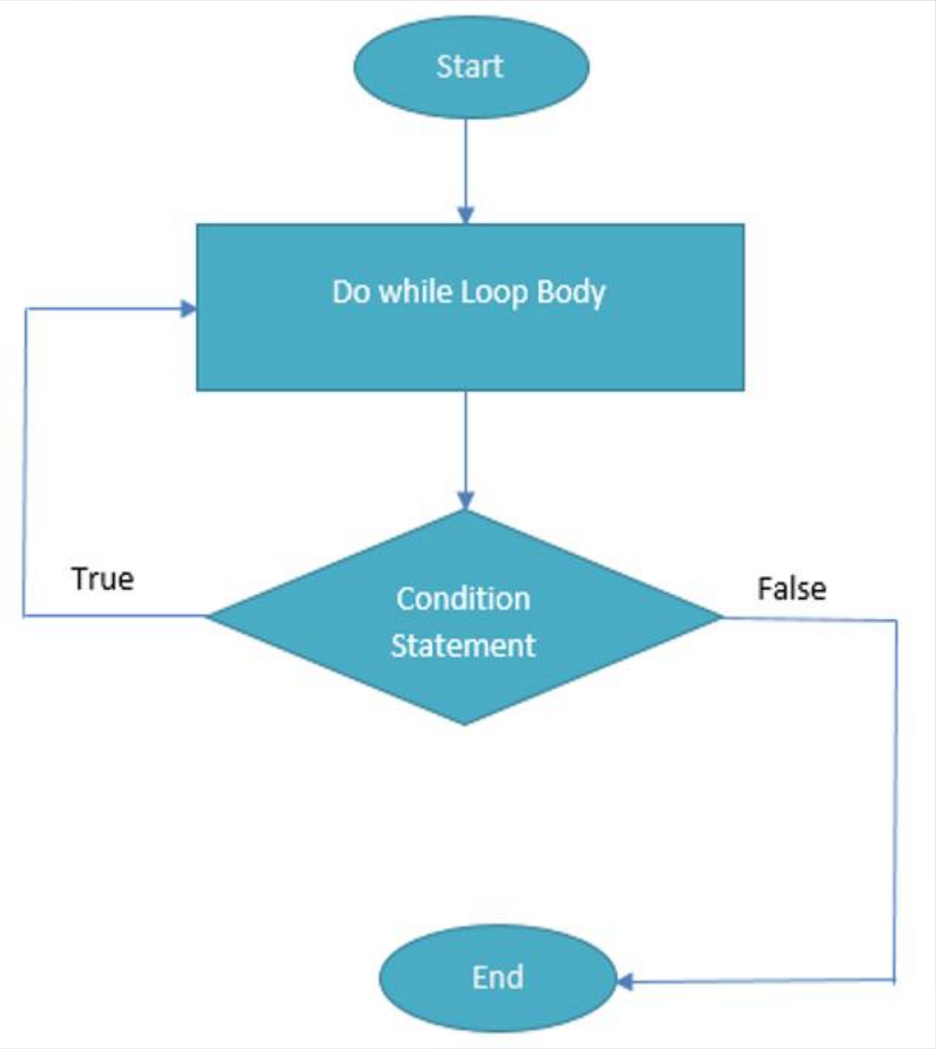
Do-while loop :

it is use to executes the code block at least once irrespective checking of condition, and then repeats the loop as long as the condition is true.

Exa :

```
do { // Code
 } while (condition);
public class Test {
public static void main(String[] args) {
int i = 1;
do {
System.out.println(i);
i++;
} while (i <= 5);
}
}
```

o/p - 1
2
3
4
5



block diagram :- Do-while loop

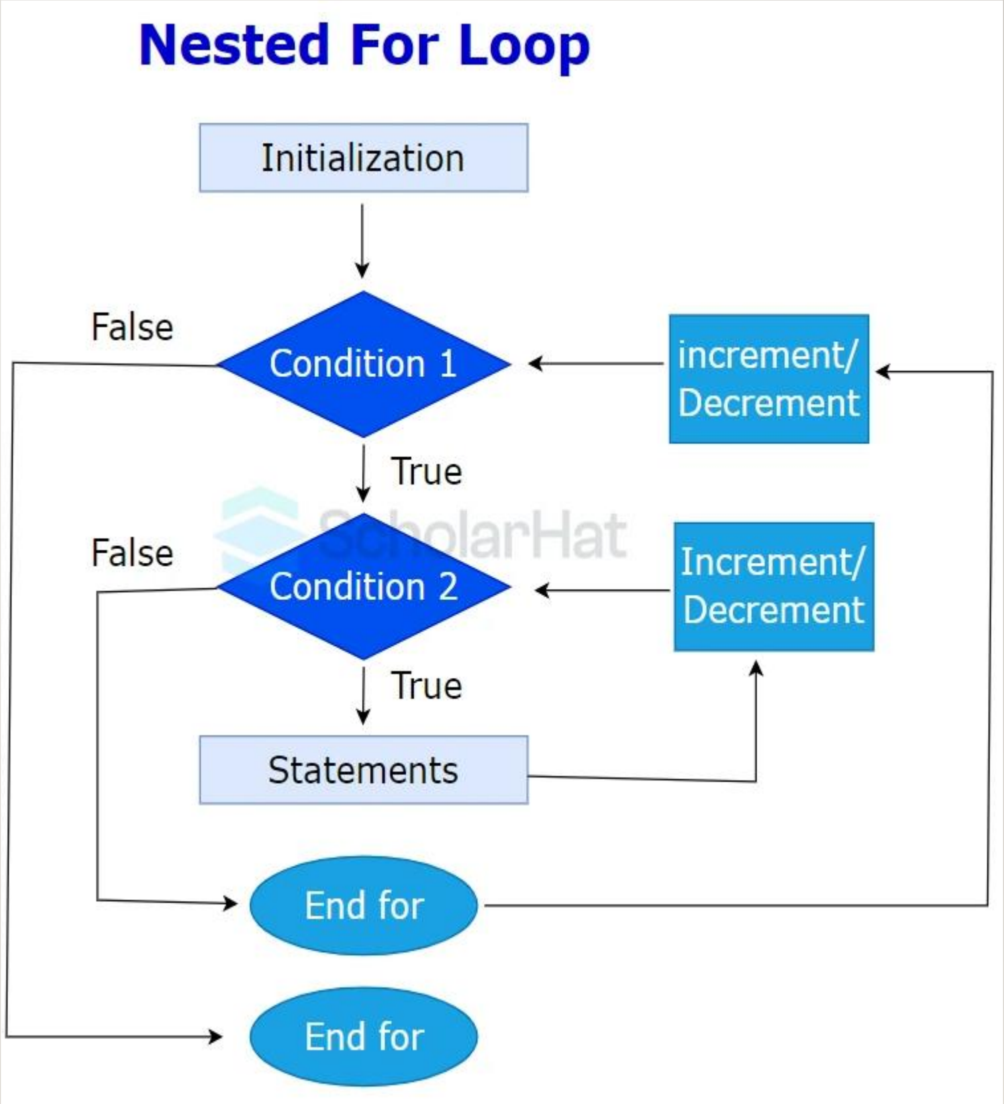
Nested-for loop :

it is a loop inside another loop. The inner loop runs completely for each iteration of the outer loop.

Exa :

```
public class Test {
public static void main(String[] args) {
for (int i = 1; i <= 3; i++) { // Outer loop
for (int j = 1; j <= 2; j++) { // Inner loop
System.out.println("i = " + i + ", j = " + j);
}
}
}
}
```

o/p :- i = 1, j = 1
i = 1, j = 2
i = 2, j = 1
i = 2, j = 2
i = 3, j = 1
i = 3, j = 2



block diagram :- **Nested-for loop**

Assignment 1

- Write a program to Print Numbers from 1 to 10 by using for lop, while loop and do while loop.
  Exa: 1 to 10 = 1 2 3 4 5 6 7 8 9 10

- WAP to Find the Sum of Numbers from 1 to N by using while loop Print Even Numbers from 1 to N
  Exa: 1 to 5 = 2 4

- WAP to reverse a Number from given rage to 1 by using scanner class and for loop.
  Exa: 1 to 5 = 1 2 3 4 5

- Write a program to print odd number from 1 to 100.
  Exa: 1 to 5 = 1 3 5

- WAP to print number which is divisible by 3 or 5 from given range using scanner class.(use mod %)
  Exa: 1 to 20 = 3 5 6 9 10 12 15 18 20

- WAP to print number which is divisible by 3 and 5 from given range using scanner class.(use mod %)
  Exa: 1 to 30 = 15 30

- WAP to print sum of Nth natural number.
  Exa 1 to 5 = 1+2+3+4+5=15

Jumping Statement :-

break: it is use in loop or switch statement to break the condition.

continue: Skips the current iteration of a loop and proceeds with the next iteration.

return: it is use in method and condition, which is use to returns a value.

Example: break, continue, return

```java
public class Example {
public static void main(String[] args) {
for (int i = 1; i <= 5; i++) {
if (i == 3) break; //Exit the loop when i==3
if (i == 2) continue; //Skip when i == 2
System.out.println(i); //Prints 1 and 4
}
System.out.println("End");
}
}
```

```java
public class ReturnExample {
public static void main(String[] args) {
int result = addNumbers(5, 3);
System.out.println("Sum: " + result);
}
public static int addNumbers(int a, int b) {
return a + b; // Return the sum of a and b
}
}
```

Q) Difference b/w for loop and while loop?

Feature	For Loop	While Loop

Syntax	for(initialization; condition; update){
	//code
	}
		while(condition){
		//code
		updates}

Initialization	Done once at the start of the loop	Done before the loop starts (outside the loop)
Condition Checking	Checked before each iteration, continues as long as true	Checked before each iteration, continues as long as true
Update	Typically done in the loop header (increment/decrement)	Done inside the loop body or in the condition
Usage	Ideal when the number of iterations.	Ideal for situations where the number of iterations is unknown.
Example	for(int i = 0; i < 5; i++){}	int i = 0; while(i < 5){ i++ }
Termination	Loop terminates when the condition is false or when break is used	Loop terminates when the condition is false or when break is used

Q) Difference b/w for do-while and while loop?

Feature	while Loop	do-while Loop
Condition Check	Condition is checked before the loop starts.	Condition is checked after the loop executes once.

Syntax	while (condition) {
	  // statements
	  Update;
	}
		do {
		  // statements
		  Update;
		} while (condition);

Use Case	Used when the loop may not need to run at all based on the condition.	Used when the loop must run at least once before checking the condition.
Flow	Executes the statements only if the condition is true initially.	Executes the statements once and then checks the condition.

Example	while (x < 5) { // code
	  Update;
	}
		do { // code
		  Update;
		} while (x < 5);

Q1) write a program to check wither the integer is positive or negative?

```
import java.util.Scanner;
public class Test {
public static void main(String[] args) {

Scanner sc = new Scanner(System.in);
System.out.println("Enter the number : ");
int num = sc.nextInt();
if (num > 0){
System.out.println(num + " is Positive");
}else if (num < 0){
System.out.println(num + " is Negative");
}else{
System.out.println("The number is Zero");
}
sc.close();
}
}
```

Q2) WAP to check whether a character is uppercase or lowercase without using built-in methods?

```
public class Test {
public static void main(String[] args) {
char ch = 'A'; // Example input
if (ch >= 'A' && ch <= 'Z')
System.out.println(ch + " is uppercase");
else if (ch >= 'a' && ch <= 'z')
System.out.println(ch + " is lowercase");
else
System.out.println(ch+"is not a letter");
}
}
```

Or down logic

```
if (ch >= 65 && ch <= 90)
System.out.println(ch + " is uppercase");
else if (ch >= 97 && ch <= 122)
System.out.println(ch + " is lowercase");
else
System.out.println(ch+"is not a letter");
```

Q) WAP to count digit in by using while loop?

```
import java.util.Scanner;
public class CountDigits {
public static void main(String[] args) {
Int number='12345';
int count = 0;
if {
while (number != 0) {
number /= 10; // Remove the last digit
count++; // Increment the count
}
}
System.out.println("Number of digits: “
+count);
}
}
```

o/p :-Number of digits: 5

Q) WAP to sum of digit by using while loop using?

```
import java.util.Scanner;
public class SumOfDigits {
public static void main(String[] args) {
Scanner scanner = new Scanner(System.in);
System.out.print("Enter a number: ");
int number = scanner.nextInt();
int sum = 0;
while (number != 0) {
sum += number % 10; // Get the last digit and add to sum
number /= 10; // Remove the last digit
}
System.out.println("Sum of digits:"+sum);
scanner.close();
}
}
```

o/p :- Sum of digits: according to input

*****spy number *****

A spy number is a number where the sum of digits is equal to the product of digits.

Exa : 123 (22, 123, 132)

Sum of digits: 1 + 2 + 3 = 6

Product of digits: 1 * 2 *3 = 6

```
public class SpyNumberCheck {
public static void main(String[] args) {
int number = 121, sum = 0, product = 1, temp = number;
while (temp > 0) {
int digit = temp % 10;
sum += digit;
product *= digit;
temp /= 10;
}
if (sum == product)
System.out.println(number + " is a spy number.");
else
System.out.println(number + " is not a spy number.");
scanner.close();
}}
```

o/p:- 112 is not a spy number

*****Strong Number :*****

A Strong Number is a number for which the sum of the factorials of its digits is equal to the number itself.

Exa : 145 = 1! + 4! + 5! = 1 + 24 + 120 = 145.

```
public class StrongNumber {
public static void main(String[] args) {
int num = 145, sum = 0, temp = num, digit;
while (temp != 0) {
digit = temp % 10;
int fact = 1;
for (int i = 1; i <= digit; i++) {
fact *= i;
}
sum += fact;
temp /= 10;
}
if (sum == num) {
System.out.println(num + " is a Strong number.");
} else {
System.out.println(num + " is not a Strong number.");
}}}
```

o/p:- 145 is a Strong number.

Assignment 2

Q) WAP to print product of even digit by using while loop using?
Exa: 12345 = 8

Q) WAP to find the first digit of a given number using a while loop?
Exa: 12345 = 1

Q) WAP to find the last digit of a given number using a while loop?
Exa: 12345 = 5

Q) WAP an integer number as input and finds the first digit raised to the power of the last digit.
Exa: 12345 = 1^5 = 1*1*1*1*1 = 1

Q) WAP to find the largest and smallest digit from a given number?
Exa: 12345 = largest digit is : 5 and smallest digit is : 1

Q) WAP to find repeated digits in a given number?
Exa: 123253 = 2 and 3

Q) WAP for Strong numbers within a given range?
Exa: 12345 =

Q) WAP that reverses the second half of a given number and print it.
Exa: 123456 = 123654

***** Palindrome Number******

Given number is equal to the reverse of the number is called palindrome number.

Exa : 12321, 909, 45654, 1001, 888, 9009, 2332, 1234321, 12321.

```
public class Palindrome {
public static void main(String[] args) {
int num = 121, originalNum = num,reversedNum = 0;
while (num != 0) {
int digit = num % 10;
reversedNum = reversedNum * 10 + digit;
num /= 10;
}
if (originalNum == reversedNum)
System.out.println(originalNum + " is a palindrome.");
else
System.out.println(originalNum + " is not a palindrome.");
}
}
```

o/p:- 121 is a palindrome.

Neon Number:

A number is a Neon number if the sum of the digits of the square of the number is equal to the number itself.

Exa : 9 = 9*9 = 81 = 8 +1 = 9 (that means 9 is neon number)

```
public class NeonNumber {
    public static void main(String[] args) {
        int num = 9, square = num * num, sum = 0;
        // Calculate the sum of the digits of the square
        while (square > 0) {
            sum += square % 10;
            square /= 10;
        }
 if (sum == num)
      System.out.println(num + " is a Neon Number.");
  else
    System.out.println(num + " is not a Neon Number.");
}
```

***Perfect square ***

Multiply the number by it self will give you perfect square number.

Exa : 2*2=4, 3*3=9, 4*4=16

```
public class PerfectSquare {
    public static void main(String[] args) {
        int num = 16,sqrt = 0;
        // Find the integer square root using a loop
        for (int i = 1; i <= num / 2; i++) {
            if (i * i == num) {
                sqrt = i;
                break;
            }
        }
        if (sqrt != 0)
System.out.println(num + " is a perfect square. Square root is " + sqrt);
        else
            System.out.println(num + " is not a perfect square.");
    }
}
```

o/p:- 16 is a perfect square. Square root is 4

*****Prime number:*****

prime number can only be divided by 1 and itself without leaving a remainder.

Exa : 2,3,5,7,11 etc.

```
public class PrimeNumber {
    public static void main(String[] args) {
        int number = 29;
        boolean isPrime = true;
        // 0 and 1 are not prime numbers
        if (number <= 1) {
            isPrime = false;
        } else {
            // Check for factors from 2 to sqrt(number)
        }
```

```
for (int i = 2; i <= number / 2; i++) {
        if (number % i == 0) {
            isPrime = false;
    break; // No need to check further
        }
    }
  }
    if (isPrime)
      System.out.println(number + " is a prime number.");
    else
      System.out.println(number + " is not a prime number.");
  }
}
```

*****Armstrong Number:*****

An Armstrong number is a number which is sumation of each degit rise to the power of total number of digit is equal to the given number.

Exa : 153 = 1*1*1 + 5*5*5 + 3*3*3 =153

```
public class Armstrong {
    public static void main(String[] args) {
        int num = 153, originalNum = num, sum = 0, digitCount = 0;
        // Counting the number of digits
        int tempNum = num;
        while (tempNum != 0) {
            digitCount++;
            tempNum /= 10;
        }
```

```
// Checking if the number is an Armstrong number
        tempNum = num;
while (tempNum != 0) {
            int digit = tempNum % 10; // Get the last digit
            sum += Math.pow(digit, digitCount); // Raise digit to
              //the power of the number of digits
            tempNum /= 10; // Remove the last digit
        }
        if (sum == originalNum)
            System.out.println(originalNum + " is an Armstrong
         number.");
        else
            System.out.println(originalNum + " is not an
         Armstrong number.");
    }
}
```

o/p:- 153 is an Armstrong number

*****Sunny Number:*****

A sunny number is a number n for which n + 1 is a perfect square. For example:

Exa : If n = 3, n + 1 = 4, which is a perfect square, so 3 is a

```
public class Main {
    public static void main(String[] args) {
        int n = 3; // Smallest sunny number candidat
        // Check if n + 1 is a perfect square
        int check = n + 1;
        int squareRoot = 1;
        while (squareRoot * squareRoot < check) {
            squareRoot++;
        }
        if (squareRoot * squareRoot == check)
            System.out.println(n + " is a sunny number.");
        else
            System.out.println(n + " is not a sunny number.");
    }}
```

o/p:- 3 is a sunny number.

*****perfect number:*****

It is a positive integer that is equal to the sum of it is proper divisor value, excluding itself.

Exa : 6 its divisors are 1, 2, 3, and 1 + 2 + 3 = 6.

```
public class PerfectNumber {
    public static void main(String[] args) {
        int number = 6, sumOfDivisors = 0;
        // Find divisors of the number and calculate their sum
        for (int i = 1; i < number; i++) {
            if (number % i == 0) { // Check if 'i' is a divisor
                sumOfDivisors += i;
            }
        }
        if (sumOfDivisors == number)
            System.out.println(number + " is a perfect number.");
        else
            System.out.println(number + " is not a perfect number.");
    }}
```

o/p:- 6 is a perfect number.

Assignment 3

Q) WAP that reverses the first half of a given number and print it?
Exa : 123456 = 321456

Q) WAP to check reverse of the number is perfect square or not?
Exa: 63 = 36 is perfect square or not.

Q) WAP to print Armstrong number between given range.
Exa: 1 to 50 =

Q) WAP to print prime number between given range.
Exa: 1 to 50=

Q) WAP to print n^{th} prime number from the number system.
Exa: 3^{rd} prime number from hole number = 5

Q) WAP to print prime number between given range.
Exa: 1 to 50 =

Q) WAP to print given number is prime number or not without using count?
Exa: 11 is prime or not. Or any number

Q) WAP to print perfect number between given range ?
Exa: 1 to 50 =

Q) WAP to print reverse Fibonacci series ?
Exa: 0 to 10 = 8 5 3 2 1 0

*****Co-prime number*****

Two numbers are said to be co-prime if their greatest common divisor (GCD) is 1.

Exa : 4 ,5 => 4%1 && 5%1 = 0

*** **Automorphic number** ***

automorphic number is a number whose square ends with the same digits as the number itself.

exa: 5 = 5*5 = 25

6 = 6*6 = 36

```
public class AutomorphicNumber {
    public static void main(String[] args) {
        int number = 5, square = number * number, temp =
number;
        boolean isAutomorphic = true;
 while (temp > 0) {
if (temp % 10 != square % 10) {
                isAutomorphic = false;
                break;
            }
            // Move to the next digit
            temp /= 10;
            square /= 10;
        }
if (isAutomorphic)
            System.out.println(number + " is an
Automorphic number.");
        else
            System.out.println(number + " is not an
Automorphic number.");
    }
}
```

o/p:- 5 is an Automorphic number.

***** Decennium number :*****

Summation of the digit rise to the power of position of the digit is called decennium number.

Exa : 175 = 1+7*7+5*5*5 = 175

```
public class Dicerium {
    public static void main(String[] args) {
        int num = 153, originalNum = num, sum = 0,
        digitCount = 0;
        // Counting the number of digits
        int tempNum = num;
        while (tempNum != 0) {
            digitCount++;
            tempNum /= 10;
        }
      tempNum = num;
      while (tempNum != 0) {
            int digit = tempNum % 10;
            sum += Math.pow(digit, digitCount);
        digitCount- -;
            //the power of the number of digits
            tempNum /= 10; // Remove the last digit
        }
        if (sum == originalNum)
          System.out.println(originalNum + " is an
          Armstrong number.");
        else
          System.out.println(originalNum + " is not an
          Armstrong number.");
    }
}
```

o/p:- 153 is an Armstrong number

*****Fibonacci series*****

The Fibonacci series is the sum of the two preceding once. The sequence typically starts with 0 and 1.

Exa :

```
public class Fibonacci {
public static void main(String[] args) {
int a = 0, b = 1, c = 0;
for (int i = 0; c < 10; i++) {
System.out.println(c);
a = b;
b = c;
c = a + b;
}
}
}
```

Output: Fibonacci Series: 0 1 1 2 3 5 8 13 21 34

WAP to swap two numbers without using a third variable?

Exa :

```
public class SwapNumbers {
    public static void main(String[] args) {
        int a = 5, b = 10;
     System.out.println("Before swap: a = " + a + ", b = " + b);
        // Swapping without using a third variable
        a = a + b; // a now becomes 15
        b = a - b; // b now becomes 5 (original value of a)
        a = a - b; // a now becomes 10 (original value of b)
        System.out.println("After swap: a = " + a + ", b = " + b);
    }
}
```

o/p:- Before swap: a = 10, b =20
after swap: a = 20, b =10

WAP to convert Integer to binary?

```
public class Test {
public static void main(String[] args) {
int n = 10, bin = 1, rem = 0;
while (n > 0) {
rem = n % 2;
bin = bin * 10 + rem;
n = n / 2;
}
int rev = 0;
while (bin > 1) {
rem = bin % 10;
bin = bin / 10;
rev = rev * 10 + rem;
}
System.out.println(rev);
}
}
```

o/p:- 1010

WAP to convert binary to integer?

```
public class Test {
public static void main(String[] args) {
int n = 1010, sum = 0, count = 0, rem = 0;
while (n > 0) {
rem = n % 2;
int p = 1;
for (int i = 0; i < count; i++) {
p = p * 2;
}
int mul = p * rem;
sum = sum + mul;
n = n / 10;
count++;
}
System.out.println(sum);
}
}
```

o/p:- 10

Assignment 4

Print pattern :

1)
```
* * * *
* * * *
* * * *
* * * *
```

2)
```
*
* *
* * *
* * * *
* * * * *
```

3)
```
* * * * *
* * * *
* * *
* *
*
```

4)
```
        *
       * *
      * * *
     * * * *
    ** * * *
```

5)
```
* * * * *
  * * * *
    * * *
      * *
        *
```

6)
```
a b c d e f
g h  i j  k l
m nop q r
s t u v w x
```

7)
```
1  2 3  4 5
A B C D E
6  7 8 9 10
F G H  I  J
```

8)
```
0
 0
  0
   0
    0
```

9)
```
0     0
 0  0
   0
 0  0
0     0
```

10)
```
1
  0
    1
      0
        1
          0
```

11)
```
*
*  *
*  *  *
*  *  *  *
*  *  *  *   *
*  *  *   *
*  *  *
*  *
*
```

11)
```
5  4  3  2  1
   4  3  2  1
      3 2  1
         2  1
            1
```

12)
```
      0
    1 0 1
  0 1 0 1 0
1 0 1 0 1 0 1
```

2)

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

```java
package test;
public class Test {
public static void main(String[] args) {
for (int i = 1; i <= 5; i++) {
for (int j = 1; j <= i; j++) {
System.out.print("*");
}
System.out.println();
}
}
}
```

3)

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

```java
public class Test {
public static void main(String[] args) {
for (int i = 1; i <= 5; i++) {
for (int j = 1; j <= 5 - i; j++) {
System.out.print(" ");
}
for (int k = 1; k <= i; k++) {
System.out.print("*");
}
System.out.println();
}
}
}
```

3)

```
a
bc
def
ghij
klmno
```

```
public class Test {
public static void main(String[] args) {
char ch = 'a';
for (int i = 1; i <= 5; i++) {
for (int j = 1; j <= i; j++) {
System.out.print(ch++);
}
System.out.println();
}
}
}
```

4)

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

```
public class Test {
public static void main(String[] args) {
for (int i = 1; i <= 5; i++) {
for (int j = 1; j <= 5 - i; j++) {
System.out.print(" ");
}
for (int k = 1; k <= 2 * i - 1; k++) {
System.out.print("*");
}
System.out.println();
}
}
}
```

5)

```
1
2 3
4 5 6
7 8 9 10
11 12 13 14 15
```

```java
public class Test {
public static void main(String[] args) {
int num = 1;
for (int i = 1; i <= 5; i++) {
for (int j = 1; j <= i; j++) {
System.out.print(num++ + " ");
}
System.out.println();
}
}
}
```

6)

```
        1
      1 2 1
    1 2 3 2 1
  1 2 3 4 3 2 1
1 2 3 4 5 4 3 2 1
```

```java
for (int i = 1; i <= 5; i++) {
for (int j = 1; j <= 5 - i; j++) {
System.out.print("  ");
}
for (int k = 1; k <= i; k++) {
System.out.print(k + " ");
}
for (int l = i - 1; l >= 1; l--) {
System.out.print(l + " ");
}
System.out.println();
}
```

7)

```
        1
      1 2
    1 2 3
  1 2 3 4
1 2 3 4 5
```

```java
public class Test {
public static void main(String[] args) {
for (int i = 1; i <= 5; i++) {
for (int j = 1; j <= 5 - i; j++) {
System.out.print("  ");
}
for (int k = 1; k <= i; k++) {
System.out.print(k + " ");
}
System.out.println();
}
}
}
```

8)

```
        1
      2 1
    3 2 1
  4 3 2 1
5 4 3 2 1
```

```java
public class Test {
public static void main(String[] args) {
for (int i = 1; i <= 5; i++) {
for (int j = 1; j <= 5 - i; j++) {
System.out.print("  ");
}
for (int k = i; k >= 1; k--) {
System.out.print(k + " ");
}
System.out.println();
}
}
}
```

9)

```
5 4 3 2 1
 4 3 2 1
  3 2 1
   2 1
    1

public class Test {
public static void main(String[] args) {
for (int i = 5; i >= 1; i--) {
for (int j = 1; j <= 5 - i; j++) {
System.out.print(" ");
}
for (int k = i; k >= 1; k--) {
System.out.print(k + " ");
}
System.out.println();
}
}
}
```

10)

```
        1
      1 0
    1 0 1
  1 0 1 0
1 0 1 0 1
public class Test {
public static void main(String[] args) {
for (int i = 1; i <= 5; i++) {
for (int j = 1; j <= 5 - i; j++) {
System.out.print(" ");
}
for (int k = 1; k <= i; k++) {
if (k % 2 == 1) {
System.out.print("1 ");
} else {
System.out.print("0 ");
}
}
System.out.println();
}}}
```

Assignment 4

Q) WAP to print reverse Fibonacci series?

Q) WAP to print reverse non-Fibonacci series?

Q) WAP to print non-Fibonacci series?

Course : Java

Part : Array, Strings And Object

Object :

Object is a piece of memory.

Syntax : Object_name obj_reference_variable_name(ORV)=new Constructor_name();

Note: new keyword is use to create object in java

Methods : There are 2 type of methods

1) Static method
2) Non-static method

Syntext to call :

```
MainMethodOrAnyMethod(){
ClassName. staticMethod();
ClassName orv = new ClassName();
orv. nonStaticMethod();
}
```

```
staticMethod(){
System.out.print("Hii");
}
```

```
nonStaticMethod(){
System.out.print("Byee");
}
```

#method without argument Syntax

Access specifier access modifier return type methodName(){
//logic or code
}

 # method with argument Syntax

Access specifier access modifier return type methodName(datatype argument){
//logic or cod
}

 # method without argument and return type Syntax

Access specifier access modifier return type methodName(){
//logic or code
return value;
}

 # method with argument and return type Syntax

Access specifier access modifier return type methodName(datatype argument){
//logic or cod
return value;
}

Static method :

Static method having single copy nature in java , that’s why it is binding during compilation time.

Non- satanic method:

Non-static method having multiple copy nature. That’s why that is binding during run time.

Non-Static Without Arguments:

```
public void displayMessage() {
    System.out.println("This is a non-static method.");
}
```

Non-Static With Arguments:

```
public int multiply(int a, int b) {
    return a * b;
}
```

Static Method Without Arguments:

```
public static void greet() {
    System.out.println("Hello, world!");
}
```

Static Method With Arguments:

```
public static void add(int a, int b) {
    System.out.println(a+b);
}
```

Static Method Without Arguments return type :

```
public static String greet() {
return “Hello, world!";
}
```

Static Method With Arguments return type:

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

Non-Static Without Arguments return type:

```
public String displayMessage() {
return “This is a non-static method";
}
```

Non-Static With Arguments return type:

```
public int multiply(int a, int b) {
return a * b;
}
```

Exa : method call

```java
public class Test {
public static void main(String[] args) {
// Calling a static method directly using the class name
staticMethod();
// Creating an object to call a non-static method
Test obj = new Test();
obj.nonStaticMethod();
}
public static void staticMethod() {
System.out.println("This is a static method.");
}
public void nonStaticMethod() {
System.out.println("This is a non-static   method.");
}
}
```

o/p:- This is a static method.
This is a non-static   method.

Exa : with argumenta method call

```java
public class Test {
public static void main(String[] args) {
// Calling a static method with arguments
int sum = addNumbers(5, 10);
System.out.println("Sum: " + sum);
// Creating an object to call a non-static method with arguments
Test obj = new Test();
int product = obj.multiplyNumbers(2, 3);
System.out.println("Product: " + product);
}
public static int addNumbers(int a, int b) {
return a + b;
}
public int multiplyNumbers(int a, int b) {
return a * b;
}}
```

o/p:-Sum: 15
Product: 6

Exa :

Static and no-static Method Without Arguments return typr:

```
public class Test {
public static int addNumbers() {
return 10+ 10;
}
public int multiplyNumbers(int a, int b) {
return a * b;
}
public static void main(String[] args) {
// Calling a static method without arguments and getting the return value
int sum = addNumbers();
System.out.println("Sum: " + sum);
// Creating an object to call a non-static method with arguments
Test orv = new Test();
int product = obj.multiplyNumbers(4, 2);
System.out.println("Product: " + product);
}}
```

wap to given number is perfect squre or not?

```
import java.util.Scanner;
public class Test {
public static void main(String[] args) {
Scanner scanner = new Scanner(System.in);
System.out.print("Enter a number: ");
int num = scanner.nextInt();
boolean isPerfectSquare = isPerfectSquare(num);
if (isPerfectSquare)
System.out.println(num + " is a perfect square.");
else
System.out.println(num + " is not a perfect square.");
}
public static boolean isPerfectSquare(int num) {
for (int i = 0; i < num; i++) {
int sqr=i*i;
if (sqr==num)
return true;
}
return false;
}}
```

Access specifier :

which is use to specify the access layer. Where to access and where not.

Type of access specifier :

1) **public :** which can be access on any where in the java .
2) **private :** which can be access on the class in the java .
3) **protected** : which can be access on the same package and subclass in the java .
4) **Default (no keyword):** Accessible only within the same package.

Access Specifier	Class	Package	Subclass	World
public	Yes	Yes	Yes	Yes
protected	Yes	Yes	Yes	No
default (no-modifier)	Yes	Yes	No	No
private	Yes	No 1	No	No

Access modifier :

They are used to define the scope of a variable or method.

Type of access modifier :

1) **Static:** which is single copy nature and which is binding during compilation time.

2) **Non-Static:** which indicate multiple copy nature and which is binding during run time.

Return type :

A return type specifies the data type of the value that a method returns to its caller. It is declared before the method name in the method declaration, if we don't return any think then put it as a void.

*****Array*****

An array is a object which is use to store elements of the same data type.

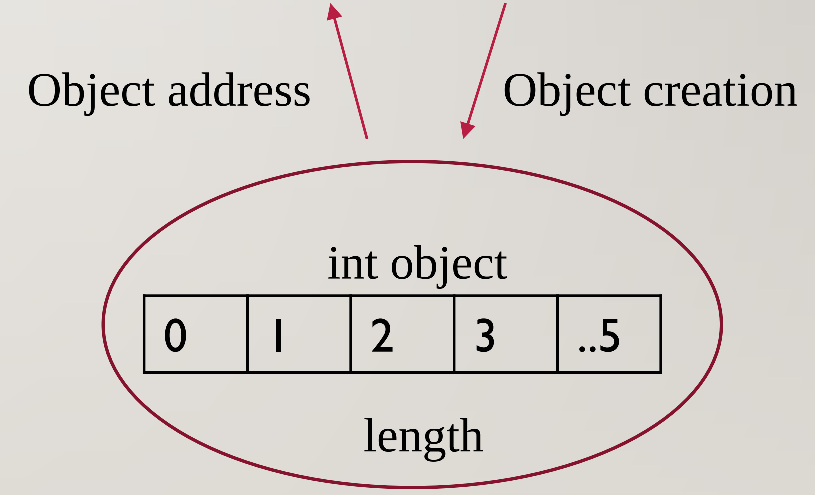
points about arrays:

Elements: Each individual value in an array is called an element.

Index: Each element is associated with an index, which is used to access it.

Declaration: Arrays are declared by specifying the data type and the size of the array.

Exa:- int[ ] numbers = new int[5];



Syntax :

1D array :

ArrayType[ ] arrayName=new ArrayType[size];

2D array:

data_type[][] array_name = new data_type[rows][columns];

Explanation Of Array Syntax :

- New keyword will create an integer array object.
- Integer array elements consist of integer values, index values start from 0.
- Integer array object consists of length variable.
- length variable consists of the length of the elements.
- Array Name consists of the object address.
- Default value of int array is 0 for each element.

Exa:-
```
public class Test {
public static void main(String[] args) {
int[] a = new int[4];
a[0] = 10;
a[1] = 20;
a[2] = 30;
a[3] = 40;
System.out.println(a[0]);
System.out.println(a[1]);
System.out.println(a[2]);
System.out.println(a[3]);
}}
```
O/p:- 10 20 30 40 print line by line

- If we initialize the elements more than the given size, we can get an exception at run time (ArrayIndexOutOfBoundsException).

Exa :By looping :

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

      a[0] = 10;
      a[1] = 20;
      a[2] = 30;
      a[3] = 40;

      for (int i = 0; i < a.length; i++) {
         System.out.println(a[i]);
      }
   }
}
```
O/p:- 10 20 30 40 print line by line

2nd method to initialize array :

```
class Array {
    public static void main(String[] args) {
        int[] a = {10, 20, 30, 40, 50};
        for (int i = 0; i < a.length; i++) {
            System.out.println(a[i]);
        }
}}
```

WAP to marge 2 integer array?

```
class Test {
public static void main(String[] args) {
int[] a = { 1, 2, 3, 4, 5 }, b = { 6, 7, 8, 9, 10 };
int[] c = new int[a.length + b.length];
for (int i = 0; i < c.length; i++) {
if (i < a.length) {
c[i] = a[i];
} else {
c[i] = b[i - a.length];
}}
for (int i = 0; i < c.length; i++) {
System.out.print(c[i] + " ");
}}}
```

Assignment 5

- WAP to print odd index array elements.

Exa: {10,20,30,40,50} =10 30 50

- WAP to print odd array elements.

Exa: {1,2,3,4,5} = 1 3 5

- WAP to print the elements which are divisible by 3.

Exa: {1,2,3,4,5,6,7,8,9,10}= 3, 6, 9

- WAP to print the sum of given array elements.

Exa: {1,2,3,4,5} = 15

- WAP to print sum of odd index array elements.

Exa: {1,2,3,4,5} = 9

- WAP to print the sum of first & last element.

Exa: {1,2,3,4,5}= 6

- WAP to swap 1st and last element.

Exa: {1,2,3,4,5} = 5 2 3 4 1

- WAP to print the given array elements in reverse order.

Exa: {1,2,3,4,5} = 5 4 3 2 1

- WAP to print palindrome no. in the given integer array (no element).

Exa: {10,11,12,13,22,55} = 11 22

- WAP to print perfect square no. from the given integer array element

Exa: {1,2,3,4,5} = 4

Q) input int[] a={2,4,6,8};
o/p:- 3 5 7 9

```java
class Test {
public static void main(String[] args) {
int[] a = { 2, 4, 6, 8 };

for (int i = 0; i < a.length; i++) {
a[i] = a[i] + 1;
}

for (int i = 0; i < a.length; i++) {
System.out.print(a[i] + " ");
}
}
}
```

WAP to print smallest and largest number?

```java
class Test {
public static void main(String[] args) {
int[] a = { -4, -5, -8, -2, -10 };
int largest = a[0];
int smallest = a[0];

for (int i = 0; i < a.length; i++) {
if (largest < a[i]) {
largest = a[i];
}

if (smallest > a[i]) {
smallest = a[i];
}
}
System.out.println("Largest:" + largest);
System.out.println("Smallest: " + smallest);
}}
```

WAP to add 100 at the 1st position of array?

```
class AddExtraElement {
    public static void main(String[] args) {
        int[] a = {3, 4, 5, 6, 7};
        int[] b = new int[a.length + 1];
        for (int i = 0; i < b.length; i++) {
            if (i == 0) {
                b[i] = 100;
            } else if (i == 1) {
                b[i] = a[i - 1];
            } else {
                b[i] = a[i - 2];
            }
        }
        for (int i = 0; i < b.length; i++) {
            System.out.print(b[i] + " ");
        }
    }
}
```

O/p:- 100 3 4 5 6 7

Reverse the array element?

```
class Test {
public static void main(String[] args) {
int[] a = { 10, 20, 30, 40, 50 };

// Reversing the array in-place
for (int i = 0; i < a.length / 2; i++) {
int temp = a[i];
a[i] = a[a.length - 1 - i];
a[a.length - 1 - i] = temp;
}

for (int i = 0; i < a.length; i++) {
System.out.print(a[i] + " ");
}
}
}
```

O/p:-50 40 30 20 10

Character array :

it is a data structure used to store a sequence of characters. Each character in the array is assigned index, starting from 0.

Syntax :

```
char[] letters = new char[5];         or         char[] vowels = {'a', 'e', 'i', 'o', 'u'};
```

Note: default value of character is space (1 empty space).

Exa :

```
class Test {
public static void main(String[] args) {
char[] a = { 'a', 'b', 'c', 'd', 'e', 'f', 'g', 'h', 'i', 'j', 'k', 'l', 'm', 'n', 'o', 'p', 'q', 'r', 's', 't','u', 'v', 'w', 'x', 'y', 'z' };

for (int i = a.length - 1; i >= 0; i--) {
System.out.print(a[i]+" ");
}
}
}
```

o/p:-z y x w v u t s r q p o n m l k j i h g f e d c b a

Q) WAP to print only alpha bate ?

```
class Test {
public static void main(String[] args) {
char[] a = { 'A', 'B', 'C', '@', 'E', '#', 'G', '*', 'I’ };

for (int i = 0; i < a.length; i++) {
if ((a[i] >= 65 && a[i] <= 90) || (a[i] >= 97 && a[i] <=
122)) {
System.out.print(a[i] + " ");
}
}
}
}
```

o/p:-A B C E G I

Assignment 7

- WAP to print given character Alphabets in descending order.

Exa: {‘a’,’d’,’x’,’t’,’c’,’m’} = x t m d c a

- WAP to print even character array element.

Exa: {‘a’,’b’,’c’,’d’,’e’,’f’} =

- WAP to print odd character array element.

Exa: {‘a’,’b’,’c’,’d’,’e’,’f’} =

- WAP to print sum of even index character array element along with their ASCII value.

Exa: {‘a’,’b’,’c’,’d’,’e’,’f’} =

- WAP to merge two character array object elements into a third character array object.

Exa: {‘a’,’b’,’c’,’d’,’e’,’f’} {‘g’,’h’,’I’}

- WAP to insert new element to the given character array element at the starting.

  Exa: {‘a’,’b’,’c’,’d’,’e’,’f’} ={‘z’,‘a’,’b’,’c’,’d’,’e’,’f’}

- WAP to merge two character array object elements into a third character array object without repeating.

  Exa: {‘a’,’b’,’c’,’d’,’f’} {‘a’,’d’,’x’,’t’,’c’,’m’}

  o/p – a b c d f m t x

- WAP to insert new character array element at the index 3.

  Exa: {‘a’,’b’,’c’,’d’,’e’,’f’}={‘a’,’b’,’c’,’z’,’d’,’e’,’f’}

Double Array in Java :

it is a data structure used to store multiple double or floting numbers.

Exa: double[] numbers = {1.23, 4.56, 7.89, 10.11}; or double[] numbers =new double[size];

```
public class DoubleArrayExample {
    public static void main(String[] args) {
        double[] prices = {19.99, 24.99, 15.99};
        for (int i = 0; i < prices.length; i++) {
            System.out.println("Price: $" + prices[i]);
        }
    }
}
```

String :

String is an Immutable object in java, as well as it is a predefine class present in side java.lang package which is introduced in JDK 1.0, in simple term string is a group of character.

New Keyword: The new keyword is used to create a new object in memory.

Object Reference Variable: The string variable stores the memory address of the String object.

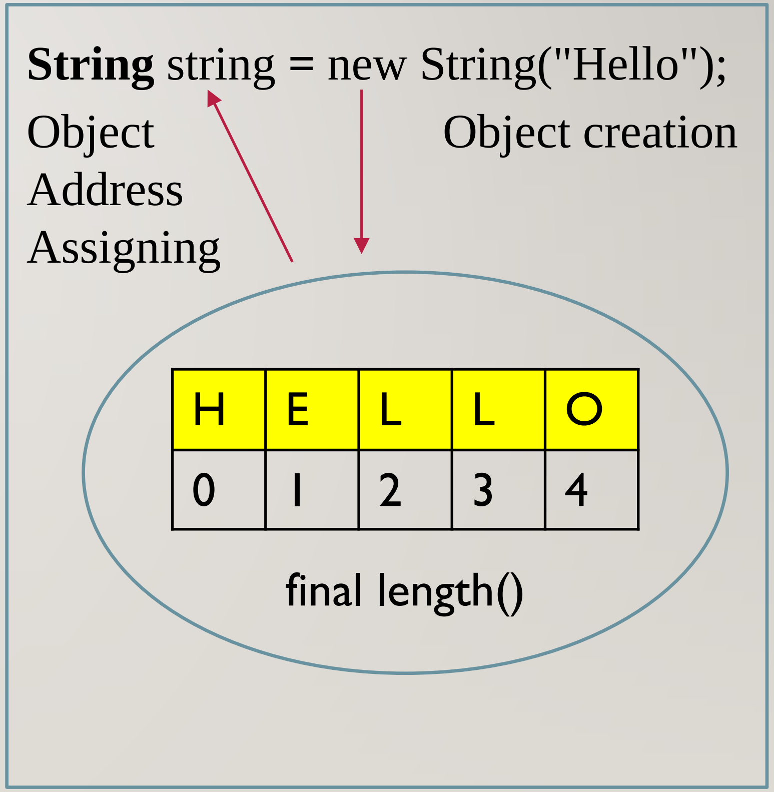
String Elements: The String object contains a sequence of characters. Each character has an index, starting from 0.

Default Value: default value of string is null.

Length(): The length() method can be used to get the length of a String object.

Immutable: Once created, their object cannot be changed. if we try to change then it will create new object and changes will happened with newly created object.

String Pool: Java uses a String pool to optimize memory usage for strings. When you create a String object, the JVM checks the String pool to see if an identical string already exists. If it does, the existing object is returned instead of creating a new one.



Types of approach to create string object :

#New Key Word Approach

- When we create an String object by using new keyword an object is created inside non-constant pool area.
- if the data is duplicated, because of new keyword, JVM will create a new object only.
- In non-constant pool area, String Object will be stored.
- We are creating foreach string new object because of new key word & then there is memory wastage.

#Literals Approach

- When we create String Objects by using literals, objects are created in side constant pool area.
- If the object is duplicated, constant pool area is telling to JVM, instead of creating a new object, share with the existing object.
- This process is known as object sharing in Java.
- In constant pool area there is no new keyword we are using literals (“ ”) so we are not creating a new object.

length(): int **:-** Returns the length of the string.

charAt(index): char :- Returns the character at the specified index.

concat(str):String :- Concatenates the specified string to the end of this string.

indexOf(str): int :- Returns the index of the first occurrence of the specified substring.

lastIndexOf(str):int :- Returns the index of the last occurrence of the specified substring.

substring(beginIndex):String :- Returns a substring starting from the specified index.

substring(beginIndex, endIndex): String :- Returns a substring starting from the specified begin Index and ending at the specified end Index.

toLowerCase(): String :- Converts all characters to lowercase.

toUpperCase(): String :- Converts all characters to uppercase.

trim(): String :- Removes starting and last whitespace.

startsWith(prefix):Boolean :- Checks if the string starts with the specified prefix.

endsWith(suffix): Boolean :- Checks if the string ends with the specified suffix.1 replace(old Char, new Char): Replaces all occurrences of the old character with the new character.

split(delimiter): String [ ]:- Splits the string into an array of substrings based on the delimiter.

equals(str): Boolean :- Compares two strings object for equality.

equalsIgnoreCase(str): Boolean :- Compares two strings object for equality, ignoring case.

Difference b/w String , String Buffer and StringBuilder ?

Feature	String	StringBuilder	StringBuffer
Definition	string is a Immutable object which contains collection of characters.	String builder is a Mutable sequence of characters.	String buffer Mutable sequence of characters.
Inbuilt Class	Yes, present in java.lang package	Yes, present in java.lang package	Yes, present in java.lang package
Introduced	Version 1.0	Version 1.0	Version 1.5
Object	All String objects are immutable	StringBuilder objects are mutable	StringBuffer objects are mutable
Methods	All methods present in String class are non-synchronized	All methods present in StringBuilder class are non-synchronized	All methods present in StringBuffer class are synchronized
Thread Safety	Because of non-synchronized nature, String objects are not thread-safe	Because of non-synchronized nature, StringBuilder objects are not thread-safe	Because of synchronized nature, StringBuffer objects are thread-safe
Performance	Because of non-thread-safe nature and multiple thread access, performance is low	Because of single-threaded access, performance is high	Because of multiple thread access, performance is high
Concatenation	concat(String)	append(String)	append(String)
Methods	equals(), hashCode(), toString()	toString()	toString()

String Array in Java

it is a data structure that stores multiple strings. It's similar to a regular array, but each element is a reference to a String object.

Exa : String[] fruits = {"apple", "banana".....}; or String[] args =new String[size];

Exa :

```
class Test {
public static void main(String[] args) {
String[] colors = { "red", "green", "blue" };
for (int i = 0; i < colors.length; i++) {
System.out.print(colors[i]+" ");
}
}
}
```

o/p:- red green blue

WAP to convert given string to character and print it?

```
class Test {
public static void main(String[] args) {
String s1 = "Hello";
char ch;
for (int i = 0; i < s1.length(); i++) {
ch = s1.charAt(i);
System.out.print(ch + " ");
}
}
}
```

o/p:- H e l l o

Note Points:

1. When two users have created two string objects, to compare both strings, we make use of the inbuilt method equals().
2. We are not supposed to use comparison operator (==) as we are not comparing primitive values. We are comparing objects.
3. When the user has just initialized the value for the strings, JVM will create one object, at that time

Exa:

```
class Palindrom {
public static void main(String[] args) {
String s1 = "mom";
String s2 = "MoM";
if (s1.equalsIgnoreCase(s2))
System.out.println("Equal");
else
System.out.println("Not equal");
}
}
```

o/p:- Equal

Assignment 8

Question from string :

1. WAP to check given string is palindrome or not.
2. WAP to reverse a given string.
3. WAP to remove a given substring.
4. I/p : s1=J%A$V@A
   o/p : s2=JAVA

WAP to check given string is palindrome or not.

```
class Test {
public static void main(String[] args) {
String s = "mom";
String rev = "";
char[] c = s.toCharArray();
for (int i = s.length() - 1; i >= 0; i--) {
rev += c[i];
}

if (s.equalsIgnoreCase(rev)) {
System.out.println("Given String is palindrome");
} else {
System.out.println("Given String is not palindrome");
}
}
}
```

o/p:- Given String is palindrome

*****Anagram*****

An anagram is a word formed by rearranging the letters of another word . For example, "listen" and "silent" are anagrams.

Note: both string length should be equal.

```
class Test {
public static void main(String[] args) {
String str1 = "listen";
String str2 = "silent";
// Convert both strings to character arrays
char[] charArray1 = str1.toCharArray();
char[] charArray2 = str2.toCharArray()
// Sort both character arrays
Arrays.sort(charArray1);
Arrays.sort(charArray2);
if (Arrays.equals(charArray1, charArray2))
System.out.println("The two strings are anagrams.");
else
System.out.println("The two strings are not anagrams.");
}
}
```

WAP to sort array via bubble sort?

```
class Test {
public static void main(String[] args) {
int[] a = { 42, 1, 7, 56, 98, 33 };

for (int i = 0; i < a.length - 1; i++) {
for (int j = 0; j < a.length -1 ; j++) {
if (a[j] > a[j + 1]) {
int temp = a[j];
a[j] = a[j + 1];
a[j + 1] = temp;
}
}
}
for (int i = 0; i < a.length; i++) {
System.out.print(a[i] + " ");
}
}
}
```

o/p:-1 7 33 42 56 98

Q) WAP to print lexicographical series from given string?

```
class Test {
public static void main(String[] args) {
String originalString =
"Aakash,Baby,Ajay,Raju,Bedprakash,Krishnamurthy";
String[] sortedString = originalString.split(",");
for (int i = 0; i < sortedString.length; i++) {
for (int j = i + 1; j < sortedString.length; j++) {
if (sortedString[i].compareTo(sortedString[j]) > 0) {
String temp = sortedString[i];
sortedString[i] = sortedString[j];
sortedString[j] = temp;
}
}
}
for (int i = 0; i < sortedString.length; i++) {
System.out.println(sortedString[i]);
}}}
```

o/p:-Aakash Ajay Baby Bedprakash Krishnamurthy Raju

WAP to print nth max or min from given array?

```
class Test {
public static void main(String[] args) {
int[] a = { 12, 35, 1, 10, 34, 1 };
int n = 2;
for (int i = 0; i < a.length; i++) {
int countL = 0, countS = 0;
for (int j = 0; j < a.length; j++) {
if (a[i] < a[j]) {
countL++;
}
if (a[i] > a[j]) {
countS++;
}}
if (countL == (n - 1)) {
System.out.println(n+"th largest no from given array is "+a[i]);
}
if (countS == (n )) {
System.out.println(n+"th smallest no from given array is "+a[i]);
}}}}
```

o/p:-2th smallest no from given array is 10
2th largest no from given array is 34

Foreach loop:

A foreach loop is a control flow statement, that iterate over the object. like arrays, lists, maps and predefine object. Introduce in JDK 1.5.

Syntax:

```
for (dataType variableName : collectionName) {
    // Code to be executed for each element
}
```

Example:

```
int[] numbers = {1, 2, 3, 4, 5};
for (int number : numbers) {
    System.out.println(number);
}
```

Feature	for Loop	foreach Loop
Syntax	for(initialization; condition; increment/decrement){ }	for(dataType variableName : collectionName) { }
Flexibility	Highly flexible, allows for precise control over the iteration process.	Less flexible, cannot modify the collection elements during iteration.
Efficiency	Less efficient as compare to foreach loop for complete iteration.	Generally more efficient for simple iterations.
Readability	Can be less readable for complex iterations.	More readable for simple iterations.

Course : Java

Part : Core Java

Class and Object (Imp) :

As soon as class is created new data type will be created this data type is called user define data type or non-primitive datatype.

User define data type

It is created by the user not predefine.

Derived data type

It is predefine data type in java.

Primitive data type

Already define in java, which having length is called primitive data type.
Exa : int, char, float, double, byte, short, long

Non-primitive data type

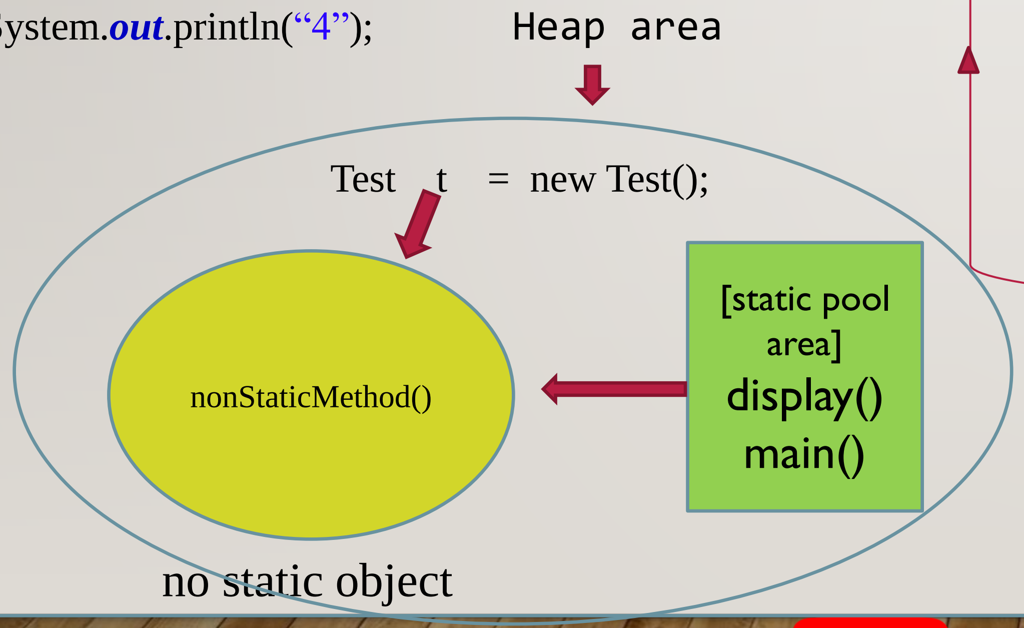
It is not introduced in java, we need to define.
Exa : String, Array, Collection and predefine class.

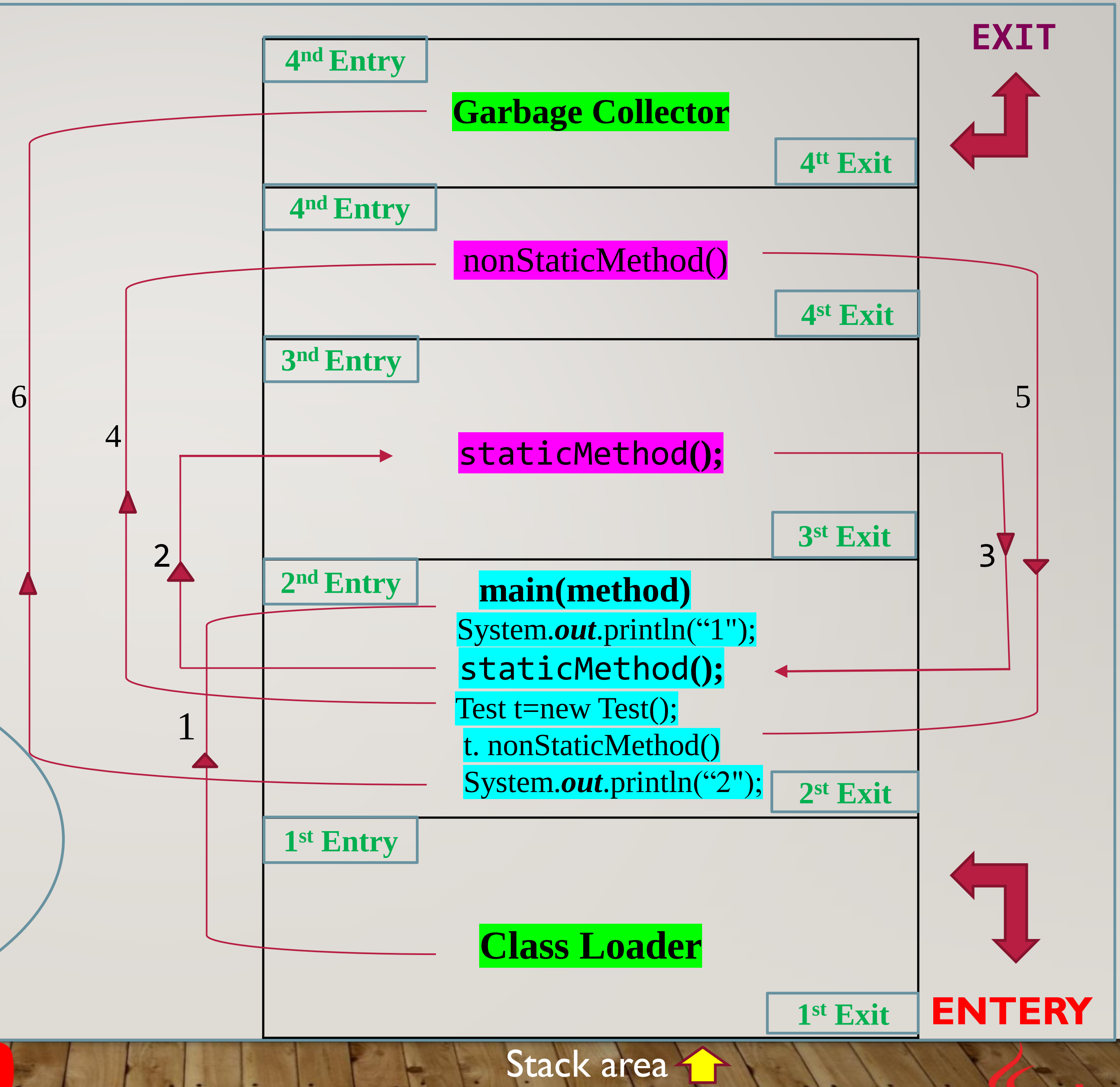
Key Point :

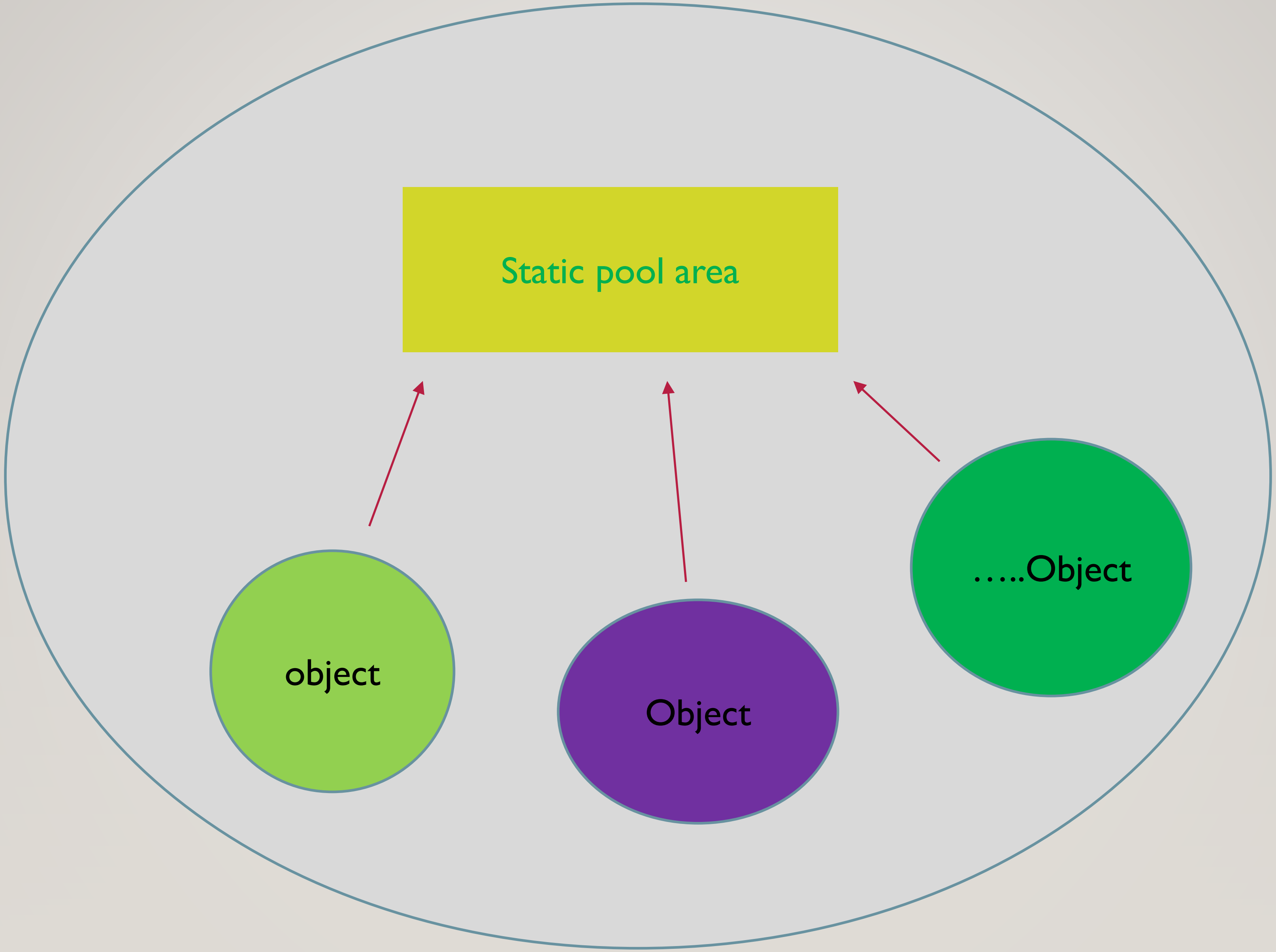
- As soon as class is created, new datatype is created
- Java language represent everything in the form of object.
- An object can be leaving or non-leaving entity.

#Execution process:

```
class Test {
public static void main(String[] args) {
System.out.println("1");
staticMethod();
Test t=new Test();
t. nonStaticMethod();
System.out.println("2");
}
public static void staticMethod() {
System.out.println("3");
}
public void nonStaticMethod() {
System.out.println("4");

}
}
```






Static pool area
object
Object
…..Object

Conclusion for execution flow

- When a Java program is executed, two memory areas are created:
  - **Stack Area**
  - **Heap Area**
- Stack Area is used for execution purposes.
- Heap Area is used for storage purposes.
- JVM makes use to call resources:
  - **Class loader**
  - **Main method**
  - **Garbage collector**
- Every operation needs to be executed in the stack area.
- Class loader is responsible to create the static pool area and load all the static methods and variable into the static pool area.
- For each class, class loader will come and load the classes once.
- The new operator is responsible to create objects and load all the non static method and variable to the heap area.
- Object address is assign to the object reference variable.
- After execution all the heap area clean by the garbage collector.

Calling method Or variable From 1 method to other :

Caller Method	Called Method	With In Same Class	With In The Different Class
static	**static**	Direct	By class name
static	**No-static**	By object reference variable Name	By object reference variable
No-static	**static**	direct	By class name
No-static	**No-static**	direct	By object reference variable

Variables are classified into three types:

1. **Global Variable(Instance Variable / class variable)**
   - Static Variable:
   - Non-Static Variable:
2. **Local Variable**
   - Local Variable:

Static Variable:

- Declared with the static keyword and class level not inside method.
- It can be accessed directly with in the class and variable initialization is not mandatory we have default value.

Non-Static Variable:

- Declared without the static keyword and class level not inside method.
- Each object has its own copy of the non-static variable and variable initialization is not mandatory we have default value

Syntax for declaring static and non-static variables:

AccessSpecifier AccessModifier dataType variableName = data;

Exa : **public static long** *ifsc*=SBI12345678;

public int *accountNumber*=12345678912;

Local Variable:

- it is declare with in the method and it is not access out of the method.
- Local variable don't have default value and it must initialize by developer.

Syntax Local variable :

dataType variableName = data;

Exa : int num=10;

Static and non static variable default value :

Data Type	Size (bits)	Default Value
byte	8	0
short	16	0
int	32	0
long	64	0L
float	32	0.0f
double	64	0.0d
char	16	( ) empty space
boolean	1	FALSE

default value for non primitive data type :

Data Type	Default Value
String	null
Array	null
Class	null
Interface	null

Method Overloading (Imp) :

Creating multiple methods with the same method name but different parameters is called method overloading, when we want to perform same operation in multiple why then we are going with method overloading.

Exa: real time example:- 1) mobile will open with password, pattern, fingerprint.

2) Multiple collages affiliated with single university.

Benefits:- Code Reusability, Improved Code Organization, Enhanced Flexibility.

```
public class MethodOverloadingExample {
    public static void sum(int a, int b) {
        System.out.println("Sum of two integers: " + (a + b));
    }
    public static void sum(double a, double b) {
        System.out.println("Sum of two doubles: " + (a + b));
    }
    public static void sum(int a, int b, int c) {
        System.out.println("Sum of three integers: " + (a + b + c));
    }
    public static void main(String[] args) {
        sum(10, 20); // Calls the first sum method
        sum(10.5, 20.5); // Calls the second sum method
        sum(10, 20, 30); // Calls the third sum method
    }}
```

Encapsulation(Imp) :

binding data members (variables and methods) into a single unit (class) is called encapsulation.

Steps of Encapsulation:

1. Declare variables as private.
2. Provide access to the variables through public methods.
3. Provide validation conditions inside the methods.

Exa : Real Time Exm:- Remote control, mobile.

Benifites:- Improved Code Organization, data security

```
class EncapsulationExample {
    private int age; // Private variable
    public int getAge() { // Public getter method
        return age;
    }
    public void setAge(int age) { // Public setter method
        if (age >= 0) {
            this.age = age;
        } else {
            System.out.println("Invalid age");
        }
    }
}
public class Main {
    public static void main(String[] args) {
        EncapsulationExample person = new
         EncapsulationExample();
        person.setAge(25); // Set the age through the setter
        int age = person.getAge();
        System.out.println("Age: " + age);
    }}
```

Constructor (Imp) :

- A constructor is a special method that is executed during object creation.
- The constructor's name must be the same as the class name.
- Constructors don't have return type.
- Constructors are by default non-static. Developers should not use the static keyword with constructors.

Syntax of a constructor:

```
accessSpecifier ConstructorName(arguments/non- arguments) {
   // Constructor body
}
```

- If a developer doesn't create any constructor, then the compiler will create a default constructor.
- A constructor without arguments and with an empty body is called a default constructor.
- **Constructors are classified into two types:**
  - **Constructor with arguments**
  - **Constructor without arguments**
- Constructors are used for performing critical operations.
- One of the common critical operations in every program is the initialization of non-static variables.
- Creating multiple constructors with different argument data types is called constructor overloading.
- Calling one constructor from another constructor is called constructor chaining.
- A constructor cannot call another constructor by using its name.

- To call another constructor, we must use the this() statement.
- To call another constructor on other class we use supper() statement.
- The this() statement informs the JVM to call the appropriate constructor based on the argument data type.
- Syntax of the this() statement:

this(arg1, arg2, ...);

- A constructor can chain with only one (single) constructor.
- To avoid breaking the above rule, the this() statement must be the first statement in the constructor.

Exa :

```
class Box {
    int width, height, depth;
    // Default constructor
    Box() {
        width = height = depth = 5;
    }
    // Parameterized constructor
    Box(int w, int h, int d) {
        width = w;
        height = h;
        depth = d;
    }}
```

Exa: Argumenta, non argumenta constructor and constructor overloading.

```
class Car {
    private String model;
    private int year;
    // Non-argumented constructor (default constructor)
    public Car() {
        model = "TATA";
        year =2024;
    }
    // Argumented constructor
    public Car(String model, int year) {
        this.model = model;
        this.year = year;
    }
    public void displayInfo() {
        System.out.println("Model: " + model);
        System.out.println("Year: " + year);
    }
}
```

```
public class Main {
    public static void main(String[] args) {
        // Creating a car object using the default
constructor
        Car car1 = new Car();
        car1.displayInfo();
        // Creating a car object using the
parameterized constructor
        Car car2 = new Car("Toyota Camry", 2023);
        car2.displayInfo();
    }
}
```

Exa: Constructor chaining by using supper() and this()

```
class Vehicle {
    protected String brand;
    protected int year;
    public Vehicle(String brand, int year) {
        this.brand = brand;
        this.year 1  = year;
    }
}
class Car extends Vehicle {
    private String model;
    public Car(String brand, int year, String model) {
        super(brand, year); // Call the parent class's constructor
        this.model = model;
    }
}
public class Main {
    public static void main(String[] args) {
        Car car = new Car("Toyota", 2023, "Camry");
    }
}
```

Inheritance(Imp) :

- It is a concept which is use to create child class based on the parent class or existing class. by using extend keyword.
- all the parent class separate copy of property will be share with the each sub class.
- Static component can not have separate copy, it will be shared with each sub class.

Use: for code reusability, Code organization, fast performance

Real Time exm: employee hierarchy, Vehicle hierarchy, Animal hierarchy.

Exa:

```
class Animal {
    public void eat() {
        System.out.println("Animal is eating");
    }}
class Dog extends Animal {
    public void bark() {
        System.out.println("Dog is barking");
    }}
public class Main {
    public static void main(String[] args) {
        Dog dog = new Dog();
        dog.eat(); // Inherited from Animal
        dog.bark();
    }}
```

Types of inheritance :

1. Single level inheritance
2. Multi level inheritance
3. Hierarchical inheritance
4. Multiple inheritance

1) Single inheritance

class Animal {}

class Dog extends

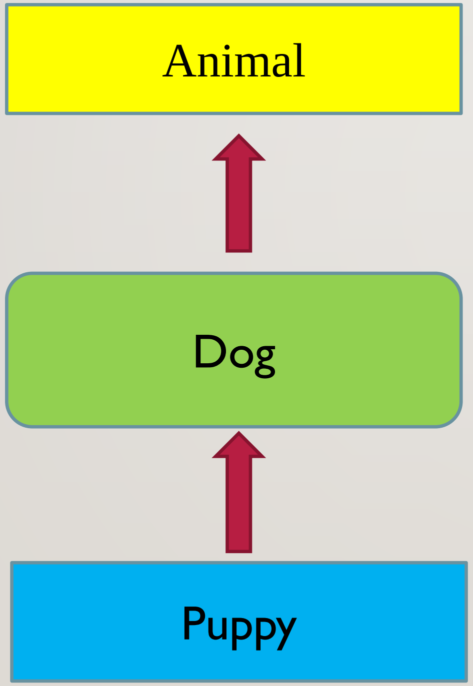
Animal {}

2) Multilevel inheritance

class Animal {}

class Dog extends Animal {}

class Puppy extends Dog {}

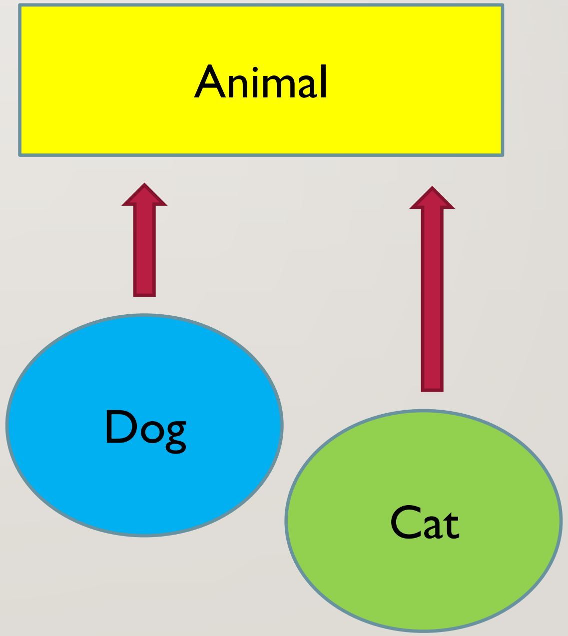


3) Hierarchical inheritance

class Animal {}

class Dog extends Animal {}

class Cat extends Animal {}



4) Multiple inheritance

single subclass havening multiple supper class is called Multiple inheritance

Multiple inheritance is not possible in java class. Because of Dimond and ambiguity problem.

Ambiguity problem :

- it is a constructor chaining problem, if we have 1 subclass and multiple supper class the we will try to call super class default or same argumenta constructor then it will give ambiguity error.

```
Class A{
public A(){
//code
}}
```

```
Class B{
public B(){
//code
}}
```

```
Class C extends A, B{
public A(){
      super(); //ambiguity
}}
```

Dimond problem :

If we have 1 sub class and multiple supper class and supper class having same method and we try to call from sub class to the supper class method then we will get ambiguity problem.

```
Class A{
public static walk(){
//code
}
}
```

```
Class B{
public static walk(){
//code
}
}
```

```
Class C extends A, B{
supper.walk();
}
```

Interface (Imp) :

- As soon as interface is created, new data type is created. This data type is called a user-defined data type or derived data type non-primitive data types.
- As soon as interface are created, new blueprints are created.
- In interface all the methods are by default public and abstract.
- In interface all the variables are by default final and static.
- Class extends class
- Class extends class and implements interface
- Class implements multiple interfaces
- Interface extends interface and Interface extends multiple interfaces
- Multiple inheritance is achievable using interface because there is no diamond problem because:
  - Interface does not allow constructors.
  - Have no ambiguity in constructor chaining.

Types Of Inheritance by using interface :

1) Single inheritance

interface Animal {}

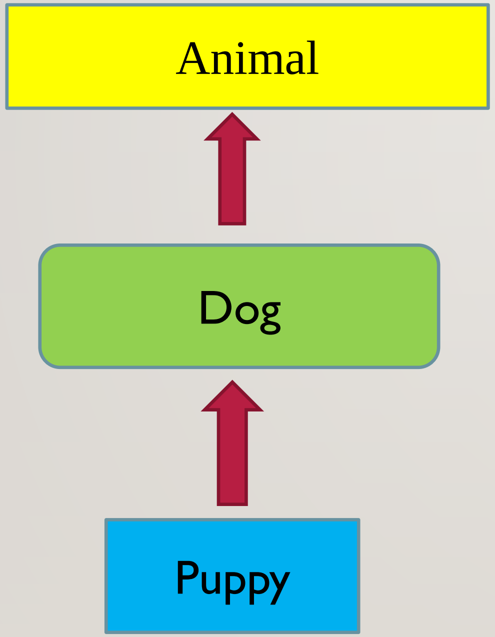
class Dog extends Animal {}

2) Multilevel inheritance

interface Animal {}

interface Dog extends Animal {}

interface Puppy extends Dog {}

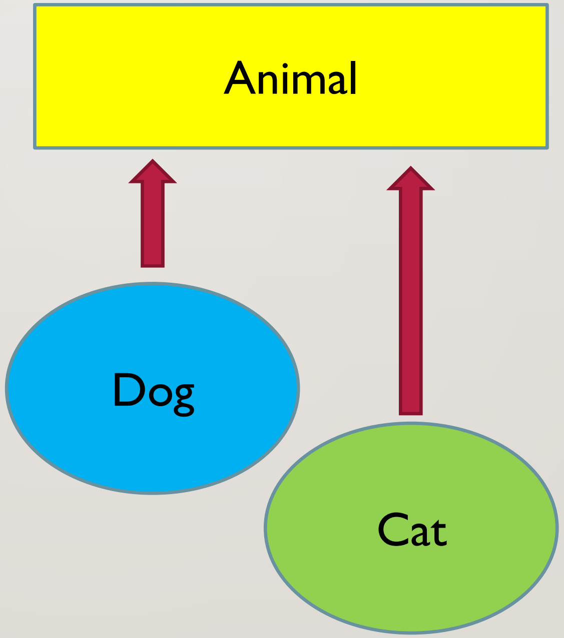


3) Hierarchical inheritance

interface Animal {}

interface Dog extends Animal {}

interface Cat extends Animal {}

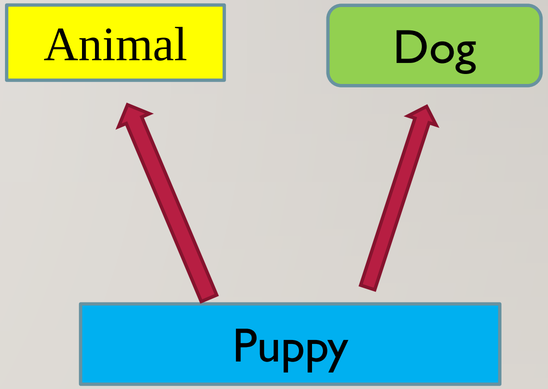


4) Multiple inheritance

interface Animal {}

interface Dog {}

interface Puppy extends Dog, Animal{}



Ambiguity problem :

- In interface does not allow constructor so there is no ambiguity problem.

Dimond problem :

In interface only method signature is there , there is no method implementation so we don’t have diamond problem.

```
interface A{
public static walk();
}
```

```
interface B{
public static walk();
}
```

```
interface C extends A, B{
public static walk(){
//code
}
}
```

1) Single-Level Inheritance

```
interface Animal {
    void eat();
}
class Dog implements Animal {
    public void eat() {
        System.out.println("Dog is eating");
    }
}
```

2) Multiple-Level Inheritance:

```
interface Pet {
    void pet();
}
interface Animal extends Pet {
    void eat();
}
class Cat implements Animal {
    public void eat() {
        System.out.println("Cat is eating");
    }
    public void pet() {
        System.out.println("Petting the cat");
    }
}
```

3) Multiple Inheritance:

```
interface Flyable {
    void fly();
}
interface Swimmable {
    void swim();
}
class Duck implements Flyable, Swimmable {
    public void fly() {
        System.out.println("Duck 1 is flying");
    }
    public void swim() {
        System.out.println("Duck is swimming");
    }
}
```

4) Hierarchical Inheritance:

```
interface Vehicle {
    void move();
}
interface Car extends Vehicle {
    void drive();
}
interface Bike extends Vehicle {
    void ride();
}
class Sedan implements Car {
    public void move() {
        System.out.println("Sedan is moving");
    }
    public void drive() {
        System.out.println("Driving a sedan");
    }
}
```

Diff b/w class and interface ?

Feature	Interface	Class
Definition	A blueprint of a class. It defines a set of methods that a class must implement.	A blueprint of an object. It defines the properties and behaviors of an object.
Keyword	interface	class
Inheritance	Multiple inheritance is possible.	Single inheritance is possible.
Methods	All methods are abstract.	Can have both abstract and concrete methods.
Variables	All variables are public, static, and final (constants).	Can have variables of different types.
Instantiation	Cannot be instantiated directly.	Can be instantiated to create objects.

Is-A Relationship (Inheritance) (Imp) :

This relationship represents a hierarchical relationship between classes. A subclass "is a" type of its superclass.

example: Dog is an Animal.

```
class Animal {
 }
class Dog extends Animal {
}
```

Has-A Relationship (Composition/Aggregation) (Imp) :

This relationship represents a "whole-part" relationship between classes. A class "has a" reference to another class.

example: car has a engine

```
class Car {
    private Engine engine=new Engine();
}
class Engine {
}
```

Feature	Is-A Relationship (Inheritance)	Has-A Relationship (Composition/Aggregation)
Keyword	extends	No specific keyword
Relationship	Hierarchical	Whole-part
Access	Inherited members can be accessed directly	Members of the composed object need to be accessed through its reference
Lifetime	Lifetime of the child object is tied to the parent object	Lifetime of the composed object is independent of the container object

#Type Casting(Imp) :

type casting means converting one object type to look like another object type. Is called object type casting.

Object type casting is classified into two types:

1. **Upcasting**
    - Converting a subclass object to look like a superclass object by hiding subclass properties and showing superclass properties. This process is called upcasting.
    - Upcasting is possible because of subclass object is having superclass properties.
2. **Down casting**
    - The process of converting an upcasted object to look like a subclass object by making subclass properties visible. This process is called down casting.
    - Down casting is possible only after upcasting.
    - Direct down casting is not possible. That is, we cannot directly convert a superclass object to look like a subclass object because a superclass object will not have subclass properties.

Note :

Upcasting will have zero (0) effect on method overriding because an overridden method is a superclass property, and upcasting's job is only to hide subclass properties.

Exa :1

```java
class Test {
public static void main(String[] args) {
// Upcastin
Animal animal = new Dog(); // Dog object is assigned to Animal reference
animal.eat(); // Output: Animal is eating
// Downcasting (with type checking)
if (animal instanceof Dog) {
Dog dog = (Dog) animal; // Safe downcasting
dog.bark(); // Output: Dog is barking
} else {
System.out.println("Cannot downcast to Dog");
}}}
class Animal {
public void eat() {
System.out.println("Animal is eating");
}}
class Dog extends Animal {
public void bark() {
System.out.println("Dog is barking");
}}
```

Exa: 2

```java
class Shape {
public void draw() {
System.out.println("Drawing a generic shape");
}
}
class Circle extends Shape {
@Override
public void draw() {
System.out.println("Drawing a circle");
}
}
public class Main {
public static void main(String[] args) {
Shape shape = new Circle(); // Upcasting: Circle object to Shape reference
shape.draw(); // Output: Drawing a circle
}
}
```

Method Overriding

Multiple method with same signature but implementation can be different or same is called method Overriding.

Note point :

- Inheritance is mandatory.
- A subclass can change the method implementation of inherited methods.
- Changing the method implementation of inherited methods is called method overriding.
- In order to override an inherited method, the subclass should maintain the same method signature given by the superclass.
- Overriding is not a mandatory process rather, it depends on project requirements.
- Only non-static methods can be overridden because of multiple copy nature.
- Static methods cannot be overridden because they do not support inheritance.
- Method overriding will only affect the current subclass because overriding is happening on the separate copy of the method given by the superclass.

Exa :1

```
 class Animal {
    public void makeSound() {
        System.out.println("Generic animal sound");
    }}
class Dog extends Animal {
    @Override
    public void makeSound() {
        System.out.println("Woof!");
    }}
public class Main {
    public static void main(String[] args) {
        Animal animal = new Dog();
        animal.makeSound(); // Output: Woof!
    }}
```

Exm :2

```
class Shape {
    public void draw() {
        System.out.println("Drawing a generic shape");
    }}
class Circle extends Shape {
    @Override
    public void draw() {
        System.out.println("Drawing a circle");
    }}
class Square extends
 Shape {
    @Override
    public void draw() {
        System.out.println("Drawing a square");
    }}
public class Main {
    public static void main(String[] args) {
        Shape shape1 = new Circle();
        Shape shape2 = new Square();
        shape1.draw();  // Output: Drawing a circle
        shape2.draw();  // Output: Drawing a square
    }}
```

Difference b/w method overloading and method overriding?

Feature	Method Overloading	Method Overriding
Definition	Declaring multiple methods with the same name but different parameters of argument	Declaring a method with the same method signature and implementation can be different.
Parameter List	Different	Same
Return Type	Can be different	Must be the same
Access Modifiers	Can be different	Must be the same
Compiler/Runtime Resolution	Compile-time	Runtime
Inheritance	Not necessary	necessary
Purpose	To perform same operation based on different input.	To provide a specific operation with different implementation,.
Read time example	Making drink, making rise, mobile lock open in multiple way.	Every car has a engine.

The final Keyword in Java

The final keyword in Java is used to declare java component that cannot be modified once they are initialized. It can be applied to variables, methods, and classes.

1. Final Variables:

- **Constant Variable**

```
final double PI = 3.14159;
```

- **Final Classes:**

Preventing Inheritance:

```
final class ImmutableClass { // code
}
//Error: Cannot inherit from a final class
class DerivedClass extends ImmutableClass {
//code
}
```

- **Final Methods:**
- **Preventing Overriding:**

```
class Parent {
    public final void method() {
        // code
    }}
class Child extends Parent {
    // Cannot override the final method
    public void method() {
        // code
    }}
```

- **Class-Level Constants:**

```
public class MyClass {
    public static final int MAX_VALUE = 100;
}
```

Method Binding

- Method is divided into two parts:

  1) **Method signature** 2) **Method implementation**

- Process of connecting method signature with method implementation is called method binding.
- During coding stage, developer is responsible only for creating method signature and method implementation.
- Methods are not bound during coding stage, rather methods are created during coding stage.
- Methods are bound either during compilation stage or execution stage.
- If methods are bound during compilation stage, then this binding is called compile-time binding.
- If methods are bound during execution stage, then this binding is called run-time binding.
- Compile-time binding is also known as static binding, because binding between method signature and method implementation can not be changed.
- **Run-time Binding** is also known as **dynamic binding or late binding** because the binding can be changed from one implementation to another implementation based on object creation.
- **Compile-time Binding** is also known as **early binding**, because methods are already bound before execution starts and methods are ready for execution at any point of time.

Syntext:

```
Access Specifier        Access Modifier        Return Type        MethodName()   //method signature
{
        //block of code                        //Method  implimentation
}
```

Exa:

```
public    static    void    methodName(arg/non-arg)     //method signature
{
        //block of code                        //Method  implimentation
}
```

Note: **Main Method is static for two reasons:**

1. Static methods are loaded first before non-static methods during compilation time.
2. Static methods are bound first (early binding) before non-static methods are bound.

Access Level According to access modifier :

Access Specifier	Within the Class	Within the Package	Subclasses (Same Package)	Subclasses (Different Package)	Outside the Package
public	Yes	Yes	Yes	Yes	Yes
protected	Yes	Yes	Yes	Yes	No
default (no modifier)	Yes	Yes	No	No	No
private	Yes	No	No	No	No

Abstract (Imp) :

- Methods are classified into two types:
  - **Concrete methods or complete method**
  - **In-complete methods**
- Method which has method signature as well as method implementation is called concrete method.
- Method which has only method signature is called in-complete method or abstract method.

Steps to create abstract method:

- Step 1: Create only method signature.
- Step 2: end with semi-colon.
- Step 3: Declare method as abstract.
- Step 4: Declare class as abstract.

Exa :

```
abstract class Shape {
    public abstract void draw();
}
```

Steps to use abstract method:

Step 1: Create a sub-class to inherit in-complete method.

Step 2: Complete the method or implement the method or override the method.

- ➢ If class contain even single abstract method, declare class as abstract.
- ➢ If subclass does not complete all the super class abstract methods, subclass is also abstract class.
- ➢ Declare super class as abstract class because to block super class object creation.
- ➢ Classes are declared abstract in 3 cases:

  Case 1: If class contain incomplete method, class is declared as abstract.
  Case 2: To block object creation.
  Case 3: If class contain all static members.

Exa :1

```
abstract class Shape {
    public abstract void draw();
    public void erase() {
        System.out.println("Erasing shape");
    }
}
abstract class Circle extends Shape {
    // Abstract method to be implemented by concrete subclasses
    public abstract void calculateArea();
    @Override
    public void draw() {
        System.out.println("Drawing a circle");
    }
}
class ColoredCircle extends Circle {
    @Override
    public void calculateArea() {
    // Implementation for calculating area of a circle
    }
}
```

Specialization

Process of creating a method which can take single objects. This process is called specialization and the method is called specialized method.

→ Steps to create Specialized method:

- Create specialized method.
- Create Static or non-static methods with arguments.
- Argument should be user define data type followed by object reference variable.
- Define repetitive code within specialized method.
- Call the method and pass object as an input to specialized method.

Note:

- User define data type and object type should be same.

Generalization

Process of creating a method which can take multiple objects of different types and have a common superclass. This process is called Generalization and the method is called generalized method.

→ Steps to create Generalized method:

- Create static or non-static method with arguments.
- Argument should be user-defined data type followed by object reference variable.
- Define repetitive code within generalized method.
- Call the method and pass an object as an input to generalized method.
- The passed object should be upcasted.
- User-defined data type should be superclass data type, whereas passed object should be subclass type.
- Finally we concluded, by using specialization or generalization, we can minimize code repetition and implement code reusability.

Exa : Generalization :

```
class Shape {
    public void draw() {
        System.out.println("Drawing a shape");
    }}
class Circle extends Shape {
    @Override
    public void draw() {
        System.out.println("Drawing a circle");
    }}
class Square extends Shape {
    @Override
    public void draw() {
        System.out.println("Drawing a square");
    }}
```

```
public class Main {
    public static void drawShape(Shape shape) {
        shape.draw();
    }
    public static void main(String[] args) {
        Circle circle = new Circle();
        Square square = new Square();
        drawShape(circle);
        drawShape(square);
    }
}
```

Exa : Specialization:

```
class Animal {
    public void makeSound() {
        System.out.println("Generic animal sound");
    }
}
class Dog extends Animal {
    @Override
    public void makeSound() {
        System.out.println("Woof!");
    }}
 public class Main {
        public static void  callDog(Dog dog) {
        System.out.println("Meow!");
    }
```

```
    public static void main(String[] args) {
        Dog dog1 = new Dog();
        Dog dog2 = new Dog();
        dog1.makeSound();
        dog2.makeSound();
    }
}
```

Abstraction(imp) :

- In simple words, abstraction means hiding unnecessary detail and providing access only necessary detail.
- In technical terms, abstraction means hiding method implementation detail and providing access only method signature.

Abstraction is achieved in 2 ways: By using abstract class and by using interface.

Steps to design Abstraction:

Step 1: Create an interface / abstract class.
Step 2: Create a method in interface / abstract class.
Step 3: Create implementation class / sub class.
Step 4: Implement the method / Override the method.
Step 5: Create a helper class.
Step 6: Create helper methods.
Step 7: Helper method will create object of implementation class / sub class.

Step 8: Implementation class object is upcasted to interface / superclass.
Step 9: Upcasted object is returned.
Step 10: Call the helper method.

- If the helper method is static, call the helper method by using helper class name.
- If the helper method is non-static, create helper class object, call the helper method by using helper class object.

Step 11: Helper method will return implementation class object in upcasted manner.

Step 12: Receive the object by using interface datatype followed by object reference variable.

Step 13: Use interface object reference variable to call interface methods.

Exm : 1

```
interface Shape {
    void draw();
}
class Circle implements Shape {
    @Override
    public void draw() {
        System.out.println("Drawing a circle");
    }
}
class HelperClass {
    public static Shape getShapeObject() {
            Shape shape=new Circle();
        return shape;
    }}
public class Main {
    public static void main(String[] args) {
        Shape shape = HelperClass.getShapeObject();
        shape.draw();  // Output: Drawing a circle
    }}
```

Use Case :

1. Security
2. Code Reusability
3. Making Code organized

Real-World Examples of Abstraction:

1. Remote Control
2. Car Driving
3. Software Libraries

Polymorphism

- Polymorphism means single entity having multiple forms.
- Polymorphism classified into two types:

  1. **Compile-time polymorphism**
  2. **Run-time polymorphism**

➢ Run-time polymorphism

- Call to overridden method is decided during runtime based on the object creation. This is called runtime polymorphism.
- To achieve runtime polymorphism, we need to use:

  1. **Interface/Superclass/abstract class**
  2. **Implementation class/subclass**
  3. **Method overriding.**
  4. **Generalization**
  5. **Upcasting**

➢ Compile-time polymorphism

- Call to overloaded method is decided during compilation time based on the argument list. This is called compile-time polymorphism.
- In order to achieve compile-time polymorphism, we need to use:

  1. **Static methods**
  2. **Method overloading**

Real time Exa:

Shape Interface, Animal Sounds, Remote Control.

Use Cases:

Method Overriding, Method Overloading, Interface-Based Programming

Benefits :

Code Reusability, Flexibility, Maintainability

Exa : Run time polymorphism

```
class Animal {
    public void makeSound() {
        System.out.println("Generic animal sound");
    }
}
class Dog extends Animal {
    @Override
    public void makeSound() {
        System.out.println("Woof!");
    }
}
public class Main {
    public static void main(String[] args) {
        Animal animal1 = new Dog();
        animal1.makeSound(); // Output: Woof!
    }
}
```

Exa : Compile time polymorphism

```
class Calculator {
    public static int add(int a, int b) {
        return a + b;
    }
    public static double add(double a, double b) {
        return a + b;
    }
}
public class Main {
    public static void main(String[] args) {
        int sum1 = Calculator.add(2, 3);
        double sum2 = Calculator.add(2.5, 3.5);
    }
}
```

instanceof keyword :

The instanceof keyword in Java is used to check if an object is belong to particular class or interface or not, ensuring type safety during down casting.

Syntex :

boolean result = object instanceof ClassName;

Exa : 1

```
class Animal {
    public void makeSound() {
        System.out.println("Generic animal sound");
    }
}
class Dog extends Animal {
    public void bark() {
        System.out.println("Woof!");
    }
}
```

```
public class Main {
    public static void main(String[] args) {
        Animal animal = new Dog();

        if (animal instanceof Dog) {
            Dog dog = (Dog) animal; 1
            dog.bark(); // This will print "Woof!"
        } else {
            System.out.println("Animal is not a Dog");
        }
    }
}
```

Exa :2

```
Boolean isString="Hii" instanceof String;
```

Course : Java
Part : Java Library

#**Lambda**

- **Lambda expression** is an anonymous function that doesn't have a name, modifiers, or return type.
- Lambda expressions work only with functional interfaces, which are interfaces that contain only one abstract method.
- By using lambda expressions, we can convert Java from an object-oriented language to a functional programming language. Functional programming means any operation doesn't need to be written in an elaborate way. By using lambda expressions, we can simplify the code. This simplification process is known as functional programming.
- Lambda expressions were introduced in the year 2014 and in the JDK version of 1.8.

Syntax:

(parameter list) -> lambda body

Exa :1

```
import java.util.Arrays;
import java.util.Collections;
import java.util.List;
public class LambdaExample {
    public static void main(String[] args)
 {
        List<String> names = Arrays.asList("Alice", "Bob",
"Charlie",
 "David");
        // Sort the list using a lambda expression
        Collections.sort(names, (a, b) ->
        a.compareToIgnoreCase(b));
        // Print the sorted list
        for (String name : names) {
            System.out.println(name);
        }
    }
}
```

#Object Class

- **Object class** is an inbuilt class present in the java.lang package.
- **Object class** is the super most class present in Java.
- **Object class** contains common methods which will be applicable in any type of object, so that the name they have given it is Object.
- In between our class and Object class, there is an implicit inheritance.
- When a developer needs to perform inheritance, the compiler itself will be performing the inheritance.
- Object class contains **11 common methods** which will be applicable in all the classes present in Java.
- All the object class methods are **non-static methods**.
- Object class properties follow **1st method** as:
- While performing inheritance, we have to create an object of the subclass. By using the subclass object reference variable, we are going to access object class properties.

Object class methods:

1. **toString()**: String
2. **equals(Object obj)**: boolean
3. **hashCode()**: int
4. **getClass()**: Class<?>
5. **clone()**: Object
6. **wait()**: void
7. **wait(long timeout)**: void
8. **wait(long timeout, int nanos)**: void
9. **notify()**: void
10. **notifyAll()**: void
11. **finalize()**: void

toString(): String

- It is non static method, in entire java toString() will be executed without calling, that's why we are calling this special method.
- Example: System.out.println(new Object().toString());

equals(Object obj): boolean

- Compares this object with the specified object for equality.
- Example: String s1 = "hello"; String s2 = "hello"; System.out.println(s1.equals(s2));

hashCode(): int

- Returns a hash code value for the object.
- Example: Integer i = new Integer(10); System.out.println(i.hashCode());

getClass(): Class<?>

- Returns the Class object associated with this object.
- Example: String s = "hello"; System.out.println(s.getClass());

clone(): Object

- Creates and returns a copy of this object.
- Example: Object obj = new Object(); Object cloneObj = obj.clone();

wait(): void

- Causes the current thread to wait until another thread invokes the notify() method or the notifyAll() method for this object.
- Example: Used in inter-thread communication.

wait(long timeout): void

- Causes the current thread to wait until another thread invokes the notify() method or the notifyAll() method for this object, or a specified timeout occurs.
- Example: Used in inter-thread communication with a timeout.

wait(long timeout, int nanos): void

- Causes the current thread to wait until another thread invokes the notify() method or the notifyAll() method for this object, or a specified timeout occurs, with nanosecond precision.
- Example: Used in inter-thread communication with a precise timeout.

notify(): void

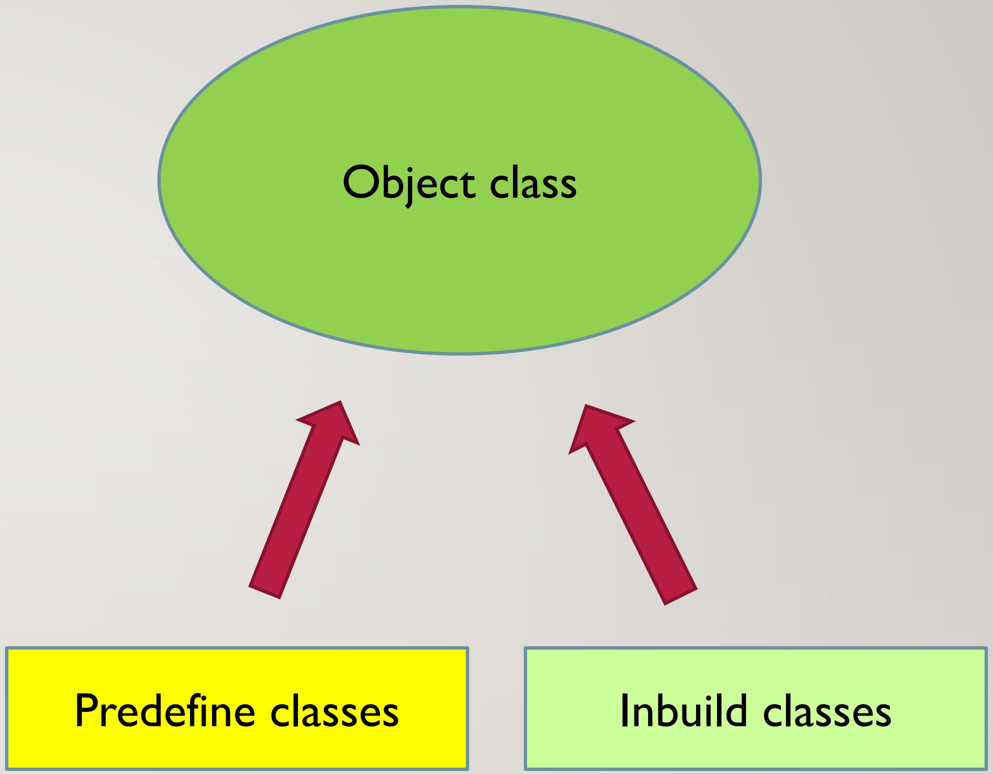
- Wakes up a single thread that is waiting on this object's monitor.
- **Example:** Used in inter-thread communication to signal a waiting thread.

notifyAll(): void

- Wakes up all threads that are waiting on this object's monitor.
- **Example:** Used in inter-thread communication to signal all waiting threads.

finalize(): void

- Called by the garbage collector on an object before it is garbage collected.
- **Example:** Can be overridden to perform clean-up tasks, but it's generally discouraged.



Why Strings are Immutable in Java

Strings is immutable, meaning their values cannot be changed once they are declared. This is called immutability, it offers several advantages.

- **Security:**

  Prevents unintended modification of sensitive data (e.g., passwords) stored as Strings.
- **Efficiency:**
  Enables String pooling, where identical String literals share the same memory location, reducing memory footprint.
- **Thread Safety:**
  Eliminates the need for explicit synchronization when multiple threads access the same String, as its value is guaranteed not to change.
- **Hashing:**
  Ensures consistent hash codes, crucial for efficient use in hash-based collections (HashMap, HashSet).
- .

Example:

```
String str1 = "Hello";

String str2 = str1.concat(" World");
```

Length :

- String implicitly implemented character array and char array length is final.

#Wrapper Class

#What is wrapper class?

- The class which will wrap the primitive data. Such classes we can call as wrapper class.

#Before wrapper class

- We can not conclude Java as 100% object-oriented language because we cannot create the object of pre-define data.

#After wrapper class

- We can conclude Java as 100% object-oriented language. Because not only for class we can create object even for predefine data also we can create the objects, by using wrapper classes.
- Each and every predefine datatype it having its own corresponding wrapper class.

Primitive data type corresponding wrapper class

Data Type	Wrapper Classes
byte	Byte
short	Short
int	Integer
long	Long
float	Float
double	Double
char	Character
boolean	Boolean

#Boxing

- The process of converting predefined data into Object is known as Boxing.
- Boxing can be done in 2 ways:
  - Explicit Boxing
  - Implicit Boxing

Explicit Boxing:

By using the new operator and constructors calling, if we do this type of boxing, such type is known as Explicit boxing.

```
package wrapper_class;
public class Explicit_Boxing_UnBoxing {
    public static void main(String[] args) {
        int intData = 10;
        Integer intObject = new Integer(intData);
    }
}
```

Implicit Boxing and Auto Boxing

- From JDK versions of 1.0 to 1.4, developers can perform only Explicit Boxing and unboxing but from JDK 1.5 developers can perform explicit and at the same time, he can also perform implicit boxing and unboxing.
- Implicit boxing is also known as auto boxing.

Exa :

```
Integer intObject = 10; // Implicit Boxing
```

#Unboxing

- The process of converting again back from object to predefined data. Is known as unboxing.
- Unboxing can be done in 2 ways:
  - Explicit Unboxing
  - Implicit Unboxing

#Implicit Unboxing/Auto Unboxing

- From JDK 1.0 to 1.4, developers can perform only explicit unboxing.
- From JDK 1.5, developers can perform unboxing in both explicit and implicit ways.
- Implicit unboxing is also known as auto unboxing.

#Explicit Unboxing

- To perform explicit unboxing, developer has to call value() method.
- This method will return corresponding primitive data.

```
int intVal = IntegerObject.intValue(); // Explicit Unboxing
byte byteVal = ByteObject.byteValue(); // Explicit Unboxing
```

```
package wrapper_class;
public class Wrapper_Class_Explicit_Boxing_Unboxing {
    public static void main(String[] args) {
        int intData = 10;
      Integer intObject = new Integer(intData); // Explicit Boxing
        int intVal = intObject.intValue(); // Explicit Unboxing
    }
}
```

```
public class BoxingUnboxingExample {
    public static void main(String[] args) {
        // Implicit Boxing
        int num = 10;
        Integer integerObject = num; // Implicitly boxed to Integer
        // Explicit Boxing
        float f = 2.5f;
        Float floatObject = new Float(f);
        // Implicit Unboxing
        int num1 = integerObject; // Implicitly unboxed to int
        // Explicit Unboxing
        char charValue = charObject.charValue();
    }
}
```

Converting Strings to Primitive Data Types in Java

To convert a string to a primitive data type in Java, you typically use the parseXXX() methods provided by the respective wrapper classes. Here are some common examples:

```
public class StringToPrimitiveConversion {
    public static void main(String[] args) {
// Conversion to Integer
        String intStr = "123";
        int intNum = Integer.parseInt(intStr);

// Conversion to Double
        String doubleStr = "3.14";
        double doubleNum = Double.parseDouble(doubleStr);

// Conversion to Boolean
        String boolStr = "true";
        boolean boolValue =  Boolean.parseBoolean(boolStr);

// Conversion to Long
        String longStr = "1234567890";
        long longNum = Long.parseLong(longStr);

// Conversion to Float
        String floatStr = "3.14f";
        float floatNum = Float.parseFloat(floatStr);

// Conversion to Character
        String charStr = "A";
        char charValue = charStr.charAt(0);
    }
}
```

Converting Primitive Data Types to Strings in Java

1. Using String.valueOf()

The String.valueOf() method is a way to convert various data types, including primitive data types, to the string.

```
int num = 42;
String str = String.valueOf(num);

double pi = 3.14159;
String piStr = String.valueOf(pi);

boolean isTrue = true;
String boolStr = String.valueOf(isTrue);

char ch = 'A';
String charStr = String.valueOf(ch);
```

2. Using toString() Method of Wrapper Classes

Each primitive data type has a corresponding wrapper class. These wrapper classes provide a toString() method to convert the primitive value to its string representation.

Exa :

```
int num = 42;
String str = Integer.toString(num);

double pi = 3.14159;
String piStr = Double.toString(pi);

boolean isTrue = true;
String boolStr = Boolean.toString(isTrue);

char ch = 'A';
String charStr = Character.toString(ch);
```

Third way of performing Boxing

- Boxing can also be done by using valueOf().
- Which is presenting corresponding wrapper classes and we have to access this method by using class name.

Ex:

1. Character charObject = Character.valueOf('#');
2. Integer intObject = Integer.valueOf(10);
3. Byte byteObject = Byte.valueOf((byte) 10);
4. Short shortObject = Short.valueOf((short) 10);
5. Long longObject = Long.valueOf(1234567890L);
6. Float floatObject = Float.valueOf(10.5F);
7. Double doubleObject = Double.valueOf(10.5);
8. String stringObject = String.valueOf("text");

#Exception(imp):

- Exception is an unexpected event faced by JVM inside Stack area.
- Once an exception occurred in our program, JVM will be immediately terminated.

#Exception Handling

The process of handling the Exception is exception handling.

- If developer has given exception handling code, exception will be handled.
- If developer does not given exception handling code, JVM will be creating an exception object and with the property of:
  - Name, Description, Location
- With this property, JVM will be calling print stack trace method implicitly.
- print stack trace method will be using this exception property and this method will trace the stack area and what all happening in stack area will be printed.
- Exception can be handled by try and catch block
  - **try block**
  - **catch block**

- All the dangerous statements should be written inside **try block**.
- All the recovery statements should be written inside **catch block**.

Syntax :

```
try {
    // Code that might throw an exception
} catch (ExceptionType1 exceptionObject1) {
    // Handle ExceptionType1
} catch (ExceptionType2 exceptionObject2) {
    // Handle ExceptionType2
} finally {
    // Code that always executes, regardless of exceptions
}
```

Exm :

```
public class ExceptionExample {
    public static void main(String[] args) {
        int[] numbers = {10, 20, 30};
        try {
            // This line might throw an
ArrayIndexOutOfBoundsException
            int value = numbers[5]; // Index 5 is out of
bounds
            System.out.println("Value: " + value);
        } catch (ArrayIndexOutOfBoundsException e) {
            System.out.println("Array index out of bounds:
" + e.getMessage());
        }
    }
}
```

a

#Exception Propagation

- The process of moving on or shifting or propagating Exception from called method to caller method.
- In our program if we use propagate Exception object from called method to caller method, this process is known as Exception propagation.

Exception propagation will done in two ways

1. Explicit propagation.
2. Implicit propagation.

There are two types of exception

1. Checked Exception
2. Unchecked Exception

Checked Exception

- If the statement is checked by compiler - those statements are known as checked statements.
- Checked exception will be getting from checked statements.
- What all the exception classes are inheriting exception super class, those exceptions are checked exception.
- Our program contains checked exception, but have to handle inside caller method.
- Examples of Checked Exception:
  - **IOException:** Occurs when an I/O operation fails, such as reading from or writing to a file.
  - **SQLException:** Occurs when a database operation fails.
  - **ClassNotFoundException:** Occurs when a class cannot be found.

Unchecked Exception

- If the statement is not checked by compiler, those statement are known as unchecked statements.
- Unchecked statement will be getting from unchecked statements.

- what an all the exception classes are inheriting run time exception super class, that will become unchecked statement exception.
- If our program contain unchecked statement we have to perform implicit propagation, implicit propagation can be done by using without throws keyword

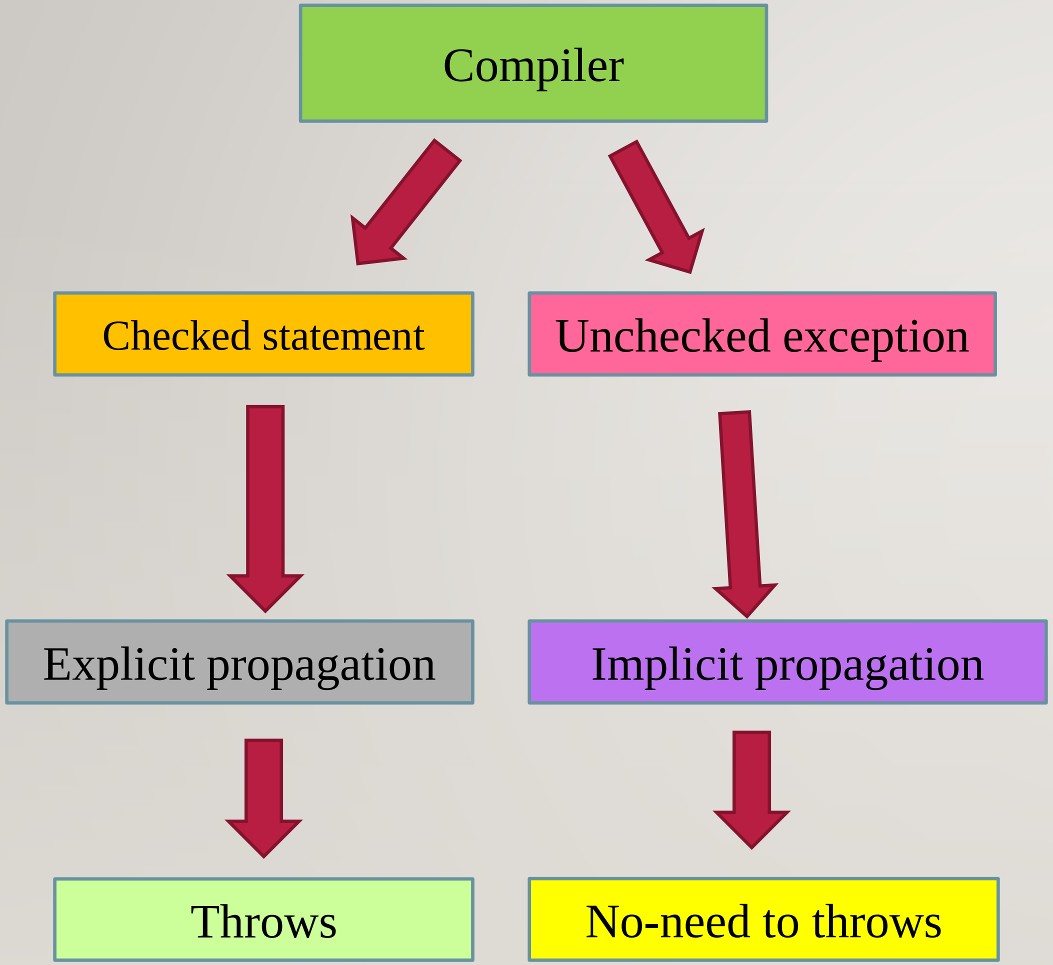
Note :

- If we are performing explicit propagation we have to make use of throws keyword followed by the exception type.

Exa:

- **NullPointerException:** Occurs when trying to use an object reference that has not been initialized.
- **ArrayIndexOutOfBoundsException:** Occurs when trying to access an array element with an invalid index.
- **ArithmeticException:** Occurs when an arithmetic operation, such as division by zero, fails.
- **ClassCastException:** Occurs when trying to cast an object to an incompatible type.
- **IllegalArgumentException:** Occurs when a method is called with an illegal or invalid argument.
- **IllegalStateException:** Occurs when a method is called at an illegal or inappropriate time.
- **IndexOutOfBoundsException:** Occurs when trying to access an index that is out of bounds of a list or array.

Exception Propagation



#User Defined Exception

- An exception created from user side this is known as user defined exception.
- To create user defined exception, a developer can create a class and class should inherit exception super class or RuntimeException super classes.
- According to the exception which you want to throw the exception, by using the try-catch block we have to catch.

How to Create User Defined Exception

1. **Create a Class**

   That class should inherit exception super class or RuntimeException super classes.

1. **Creating the exception**

We can create the exception by using the throw keyword.

1. If in case our exception wants to become unchecked exception, we need to make use of RuntimeException.

Exa :

```
public class InsufficientFundsException extends Exception {
    public InsufficientFundsException(String message) {
        super(message);
    }}
public class Account {
    private double balance;
    public void withdraw(double amount) throws
        InsufficientFundsException {
        if (balance < amount) {
         throw new InsufficientFundsException("Insufficient
         balance");
        }
        balance -= amount;
    }}
```

```
public class Main {
    public static void main(String[] args) {
        Account account = new Account();
        account.balance = 100;
        try {
            account.withdraw(200);
        } catch (InsufficientFundsException e) {
            System.out.println("Error: " + e.getMessage());
        }
    }
}
```

Diff b/w checked exception and unchecked exception?

Feature	Checked Exceptions	Unchecked Exceptions
Checked by Compiler	Yes	No
Subclass of	Exception	RuntimeException
Handling	Must be either caught or declared in the method signature using throws	Not required to be handled, but can be
Common Examples	IOException, SQLException, ClassNotFoundException	NullPointerException, ArrayIndexOutOfBoundsException, ArithmeticException
Origin	External factors like file I/O, network issues	Programming errors or unexpected conditions

Diff b/w error and exception?

Feature	Errors	Exceptions
Definition	Severe issues that indicate system problems beyond the program's control.	Unexpected events that occur during program execution due to issues within the code.
Recoverability	Generally not recoverable	Can often be recovered from using try-catch blocks.
Checked/Unchecked	All errors are unchecked.	Can be both checked and unchecked.
Responsibility	System or environment	Program code
Package	java.lang.Error	java.lang.Exception
Examples	OutOfMemoryError, StackOverflowError, VirtualMachineError	NullPointerException, ArrayIndexOutOfBoundsException, IOException, SQLException

Diff b/w throe and throws keyword?

Feature	throw Keyword	throws Keyword
Purpose	Used to create an exception	Used to throw the exception from called method to caller method and it can be one or more exceptions
Exception Type	It can create only one exception at a time	It Can throws multiple exceptions
Usage	Primarily used for unchecked exceptions	Primarily used for checked exceptions
Placement	Can be used inside methods, constructors, or conditional blocks	Must be declared in the method signature
Syntax	throw new ExceptionObject();	methodName(param1, param2) throws Exception1, Exception2 { // ... }

#Finally Block

- All the program imput statement should be given inside the finally block.
- Finally block will be executed irrespective of exception occur or not.
  1) If exception occurs catch and finally will be executed.
  2) If exception does not occur try and finally block will be executed.

Exa : public class FinallyBlockExample {

```
    public static void main(String[] args) {
        try {
            int result = 10 / 0; // throwing ArithmeticException
        } catch (ArithmeticException e) {
System.out.println("Arithmetic Exception: "+e.getMessage());
        } finally {
            System.out.println("This will always execute.");
        }}}
```

Exception Information will be printed by using following 3 methods.

1. **printStackTrace(); void**
2. **toString(); String**
3. **getMessage(); String**

1. printStackTrace(): void

- Prints a additional information about the exception like exception name, description and location of the exception.

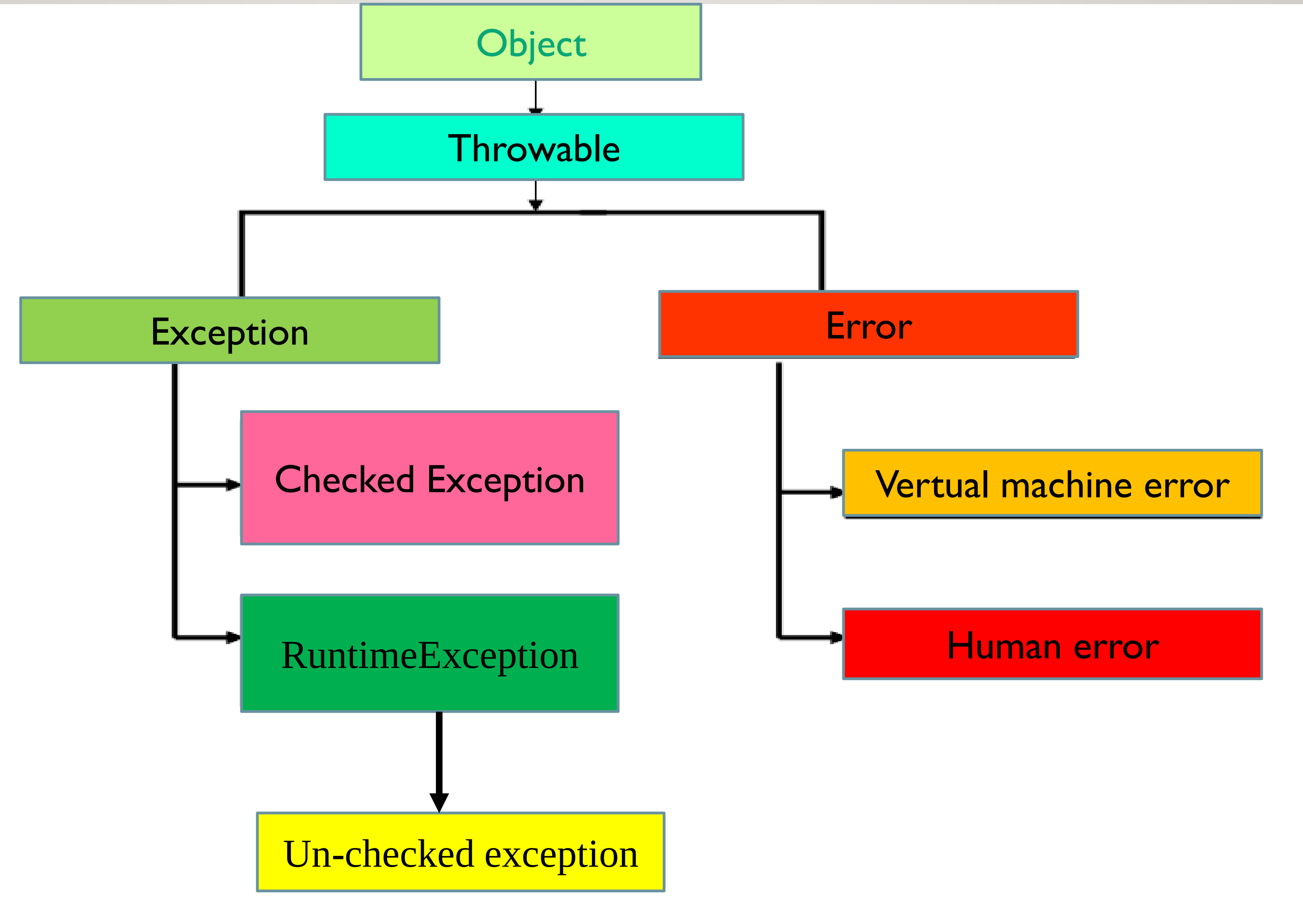
2. toString(): String

- Returns a string representation of the exception, typically including the exception's class name and a brief message.

3. getMessage(): String

- Returns the detailed message associated with the exception. This message provides additional information about the cause of the exception.

Exception hierarchy :



Collection :

A collection is a data structure that organizes and stores multiple elements, providing efficient ways to manage . It can be dynamic, store various data types, and offer operations like adding, removing, searching, and sorting.store various data types, and offer operations like adding, removing, searching, and sorting.

Diff b/w Array and collection ?

Feature	Array	Collection
Type	Object	Interface
Data Type	Homogeneous (same data type)	Heterogeneous (different data types)
Primitive Data Types	Can store	Cannot store
Fixed Size	Yes	No
Methods	Limited built-in methods	Rich set of methods for various operations

What is Collection (Interface)?

- Collection is a predefined interface in Java.
- It was introduced in version JDK 1.2.
- It is present in the `java.util` package.
- In Java, the collection framework provides a standard architecture to store groups of objects.

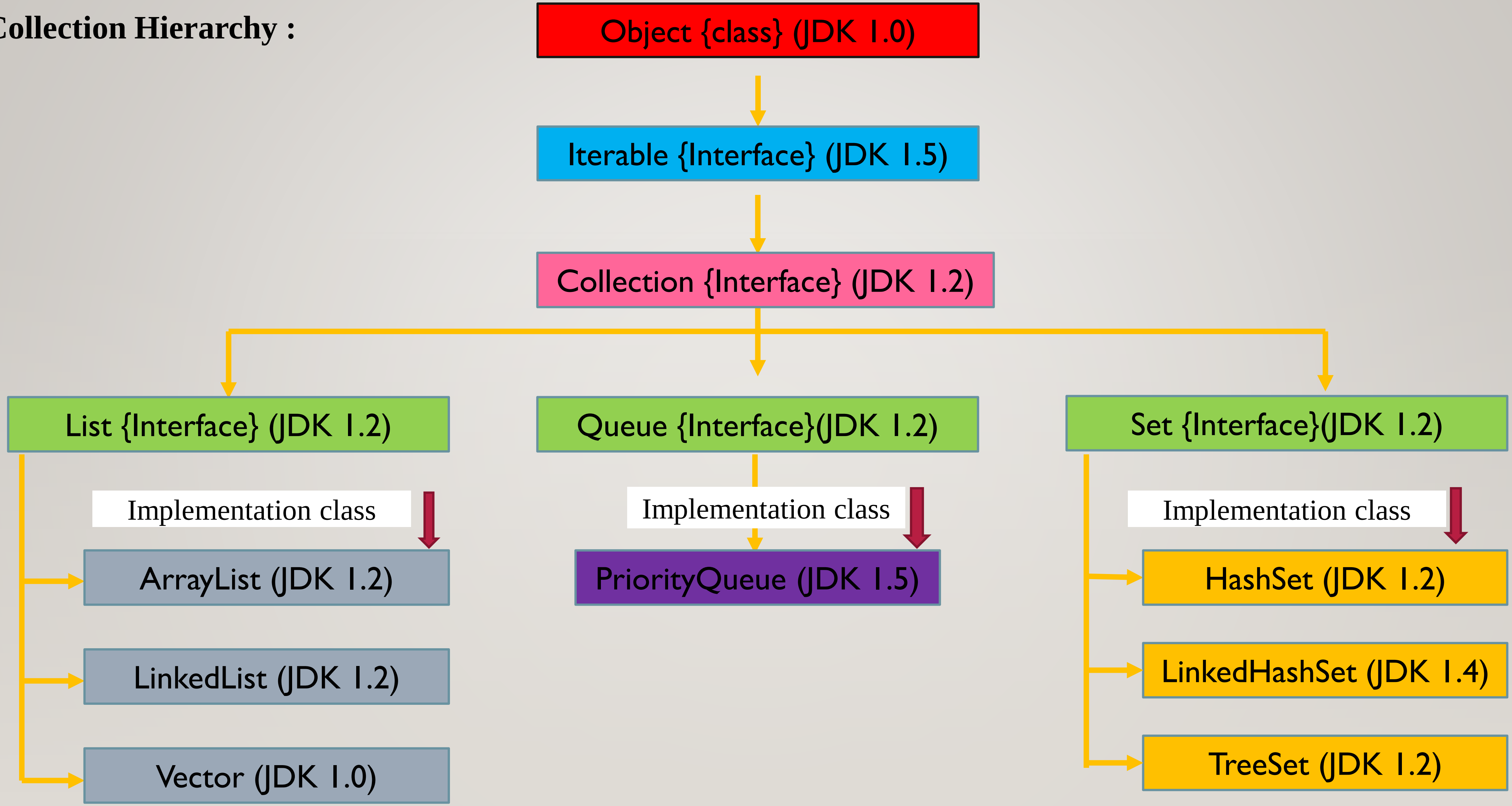
Note Point:

- Collection is nothing but a collection/group of objects.

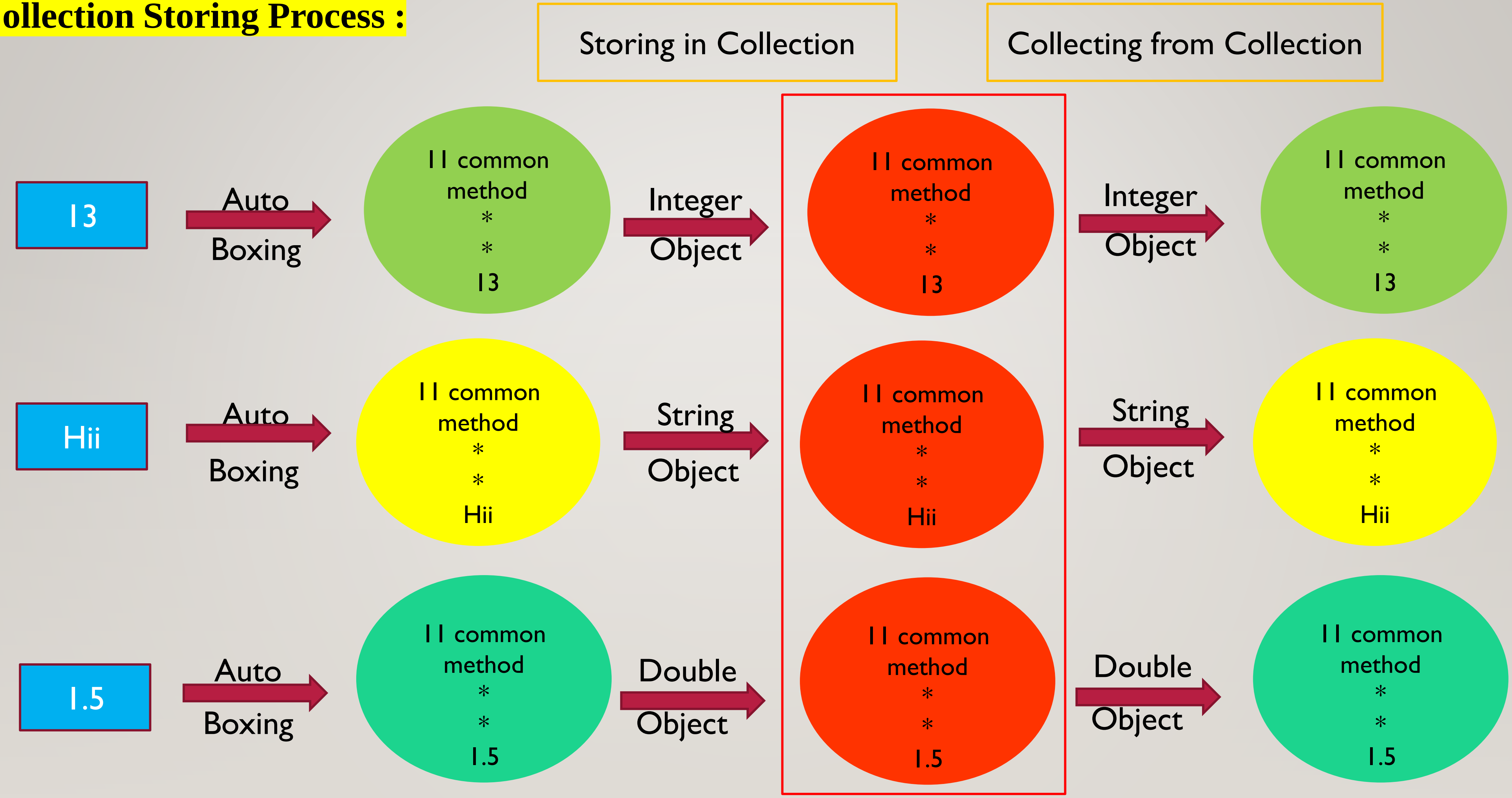
What is Framework?

- Framework represents a group of classes and interfaces.

Collection Hierarchy :



Collection Storing Process :



Diff b/w Generic Type Collection and Raw Type Collection?

Feature	Raw Type Collection	Generic Type Collection
Syntax	ArrayList list = new ArrayList();	ArrayList<ReferenceType> list = new ArrayList<ReferenceType>();
Type Safety	Not type-safe. Can hold any type of data.	Type-safe. Can only hold the defined type of data.
Compile-Time Checking	No compile-time type checking for elements.	Checked for type safety at compile-time.
Typecasting	Individual type casting needed at every retrieval.	No typecasting needed.
Generics Support	No generics support.	Full generics support.
Warnings	Generates unchecked warnings at compile time.	No unchecked warnings.
Example	list.add("hello"); list.add(123);	list.add("hello"); list.add(123); // Compile-time error

List

- List is a predefined subinterface of the Collection interface.
- It was introduced in the version of JDK 1.2.
- It is present in the java.util package.
- List interface having 4 implementation classes:
  1. ArrayList
  2. LinkedList
  3. Vector

Common qualities of List type of collection:

- It is index-based.
- It allows duplicate values.
- It allows null values.

ArrayList

- ArrayList is a predefined implementation class of the List interface.
- It was introduced in the version of JDK 1.2.
- It is present in the java.util package.
- ArrayList is index-based.
- It allows duplicate values.
- It allows null values.
- ArrayList is both homogeneous as well as heterogeneous.
- ArrayList follows insertion order.
- The initial or default capacity of ArrayList is 10 continuous memory blocks.
- The auto-growable capacity of ArrayList is half of its previous capacity + 1.

Syntax :

```
ArrayList<Character> arraylist = new ArrayList<>();
```

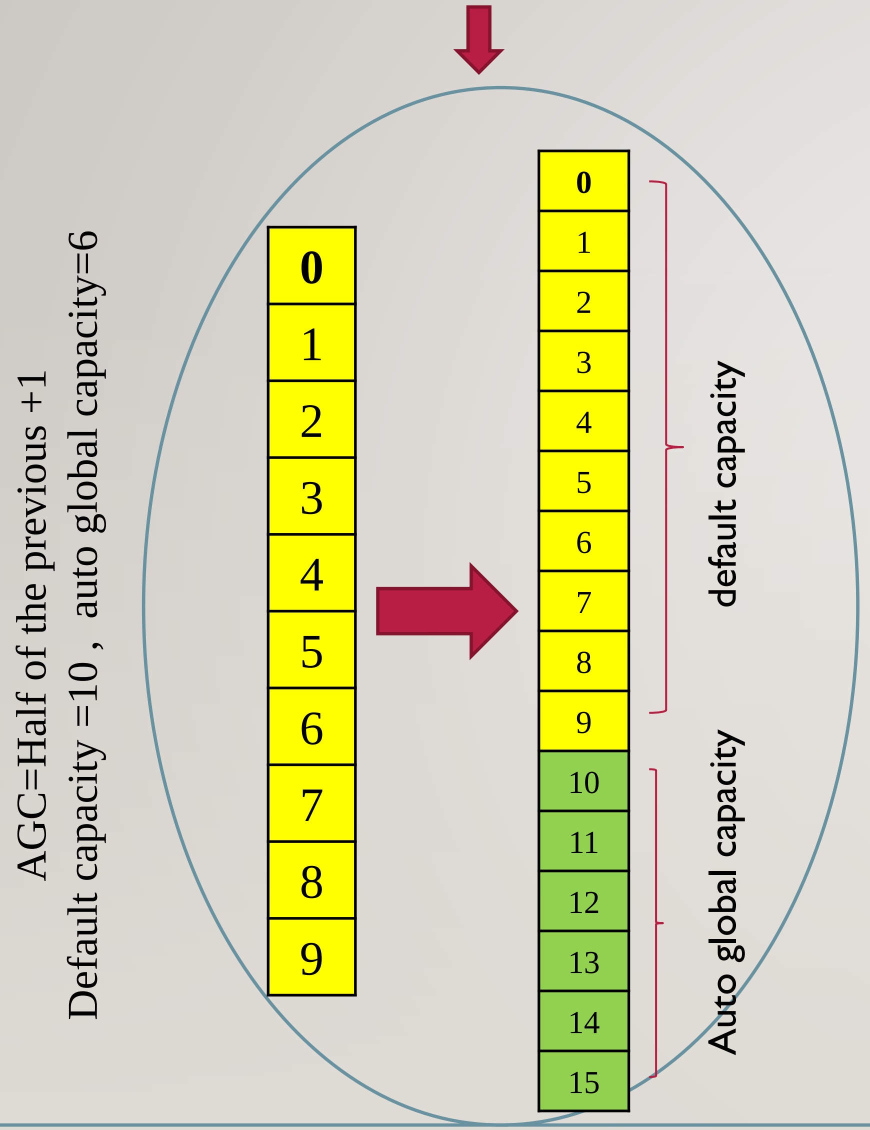
Basic Operations:

- **add(E e):** Adds the specified element to the end of the list.
- **add(int index, E element):** Inserts the specified element at the specified position in the list.
- **clear():** Removes all of the elements from this list.
- **contains(Object o):** Returns true if this list contains the specified element.
- **get(int index):** Returns the element at the specified position in this list.
- **indexOf(Object o):** Returns the index of the first occurrence of the specified element in this list, or -1 if this list does not contain the element.
- **isEmpty():** Returns true if this list contains no elements.
- **lastIndexOf(Object o):** Returns the index of the last occurrence of the specified element in this list, or -1 if this list does not contain the element.
- **remove(int index):** Removes the element at the specified position in this list.
- **remove(Object o):** Removes the first occurrence of the specified element from this list, if it is present.
- **set(int index, E element):** Replaces the element at the specified position in this list with the specified element.
- **size():** Returns the number of elements in this list.

Search and Sort:

- **containsAll(Collection<?> c):** Returns true if this list contains all of the elements of the specified collection.
- **indexOfAll(Object o):** Returns a list containing all indices of the specified element in this list.
- **lastIndexOfAll(Object o):** Returns a list containing all indices of the last occurrence of the specified element in this list.
- **sort(Comparator<? super E> c):** Sorts this list according to the order induced by the specified comparator.

```java
ArrayList<Integer> arraylist = new ArrayList<>();
```



Exa :

```java
import java.util.ArrayList;
import java.util.Arrays;
import java.util.Collections;
public class ArrayListExample {
    public static void main(String[] args) {
        // Create an ArrayList to store integers
        ArrayList<Integer> numbers = new ArrayList<>();
        // Adding elements
        numbers.add(10);
        numbers.add(20);
        numbers.add(5);
        numbers.add(15);
 // Printing the ArrayList
        System.out.println("Original ArrayList: " + numbers);
```

```
// Getting the size
        int size = numbers.size();
        System.out.println("Size of the ArrayList: " + size);
// Checking if an element exists
        boolean contains20 = numbers.contains(20);
        System.out.println("Does the ArrayList contain 20? " +
contains20);
// Getting an element by index
        int thirdElement = numbers.get(2);
        System.out.println("Third element: " + thirdElement);
// Removing an element by index
        numbers.remove(1);
        System.out.println("ArrayList after removing the second
element: " + numbers);
// Removing an element by value
        numbers.remove(Integer.valueOf(15));
System.out.println("ArrayList after removing 15:"+numbers);
```

```
// Clearing the ArrayList
        numbers.clear();
        System.out.println("ArrayList after clearing: " + numbers);
// Adding multiple elements using the addAll method
        numbers.addAll(Arrays.asList(1, 2, 3, 4, 5));
        System.out.println("ArrayList after adding multiple
elements: " + numbers);
// Sorting the ArrayList
        Collections.sort(numbers);
        System.out.println("Sorted ArrayList: " + numbers);
// Reversing the ArrayList
        Collections.reverse(numbers);
        System.out.println("Reversed ArrayList: " + numbers);
// Checking if the ArrayList is empty
        boolean isEmpty = numbers.isEmpty();
        System.out.println("Is the ArrayList empty? " + isEmpty);
   }}
```

Exa : 2

```
// Generic ArrayList to store Strings
ArrayList<String> names = new ArrayList<>();
names.add("Alice");
names.add("Bob");
names.add("Charlie");

// Generic HashMap to store key-value pairs of Integer and String
HashMap<Integer, String> map = new HashMap<>();
map.put(1, "Apple");
map.put(2, "Banana");
map.put(3, "Cherry");
```

```
// Raw ArrayList
ArrayList list = new ArrayList();
list.add("Apple");
list.add(123);
list.add(true); // This is not type-safe and can lead to runtime errors

// Raw HashMap
HashMap map2 = new HashMap();
map2.put("name", "Alice");
map2.put("age", 30);
map2.put("city", "New York"); // Again, not type-safe
```

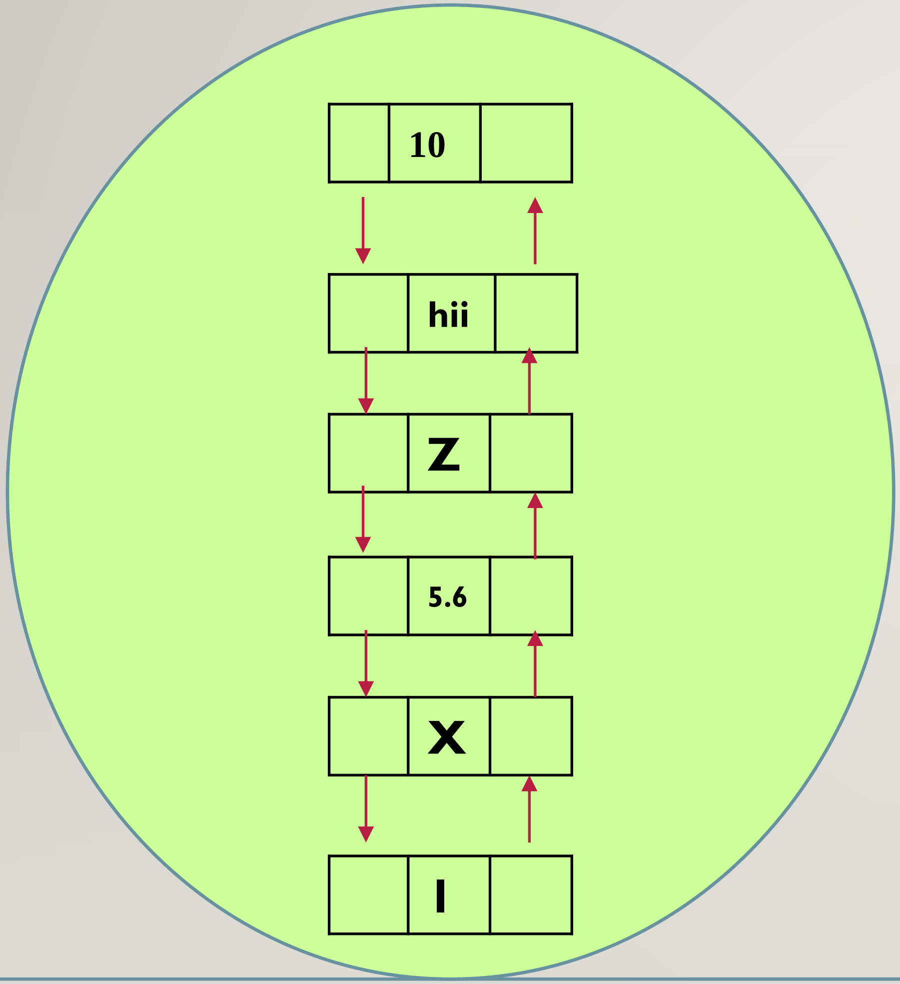
Exa : 3 retrieve element from ArrayList 1 by 1?

```
import java.util.ArrayList;

public class ArrayListExample {
    public static void main(String[] args) {
        // Create an ArrayList to store strings
        ArrayList<String> names = new ArrayList<>();

        // Add elements to the ArrayList
        names.add("Alice");
        names.add("Bob");
        names.add("Charlie");

        // Iterate through the ArrayList using a for-each
loop
        for (String name : names) {
            System.out.println(name);
        }
    }
}
```

LinkedList: (Double Linked List)

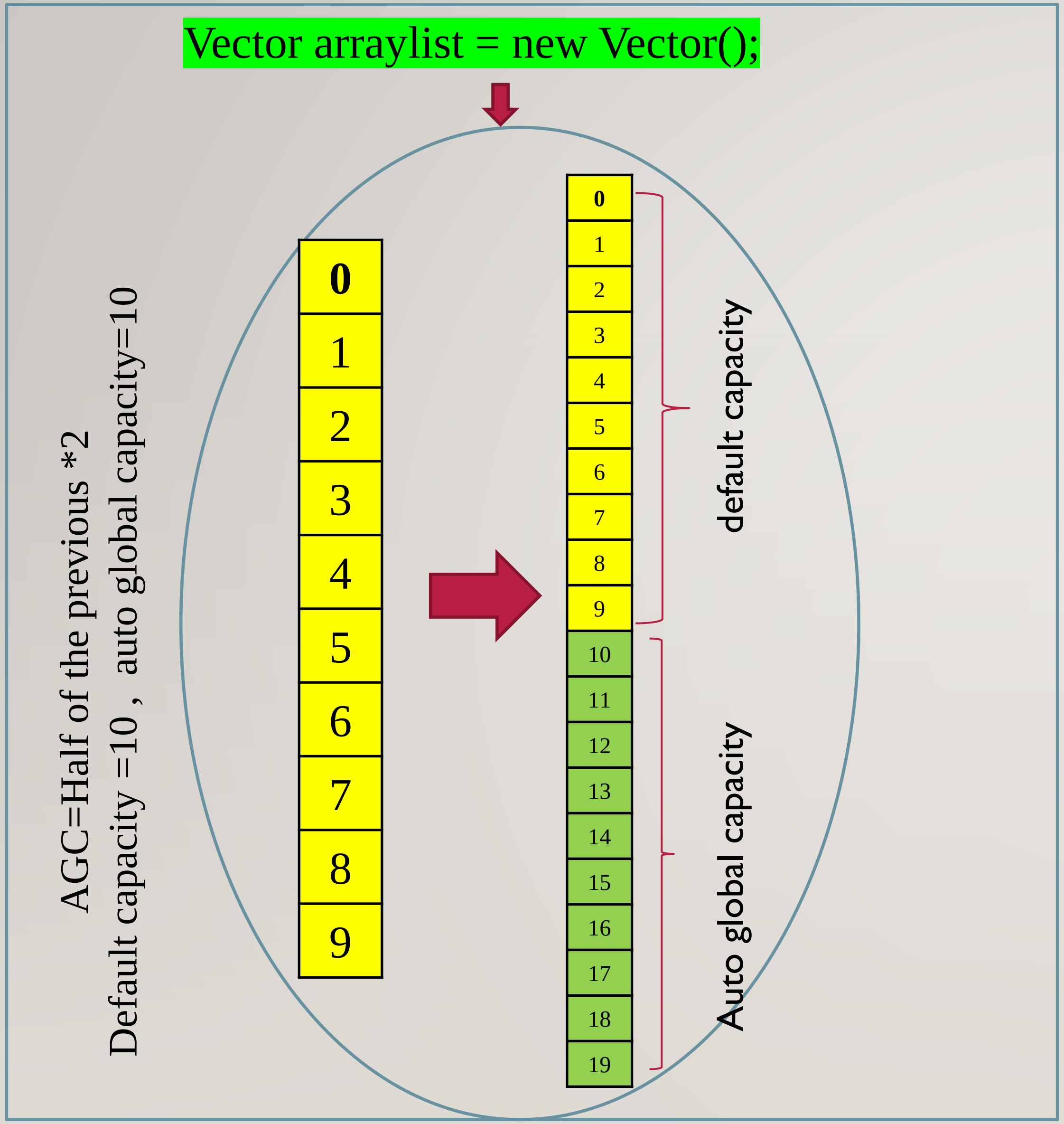
- LinkedList is a predefined implementation class of the List interface.
- It was introduced in the version of JDK 1.2.
- It is present in the java.util package.
- LinkedList is index-based.
- It allows duplicate values.
- It allows null values.
- LinkedList follows insertion order(Same inserting order).
- LinkedList is both homogeneous and heterogeneous.
- In LinkedList, there is no initial capacity.
- Whenever we are adding elements into the collection, that time instantly one memory block will get created.
- Each memory block knows where my next object is present and next object knows where my previous object is present.

Work flow and architecture :



Exa :

```java
import java.util.LinkedList;
public class LinkedListExample {
    public static void main(String[] args) {
        // Create a LinkedList to store strings
        LinkedList<String> names = new LinkedList<>();
        // Add elements to the LinkedList
        names.add("Alice");
        names.add("Bob");
        names.add("Charlie");
        // Iterating through the LinkedList using a for-each loop
        for (String name : names) {
            System.out.println(name);
        }
    }}
```



Vector/Legacy Class:

- Vector is a predefined implementation class of the List interface.
- It was introduced in the version of JDK 1.0.
- It is present in the java.util package.
- Vector class is also called as Legacy class because vector class was introduced before introducing collection.
- Vector class is thread-safe.
- It allows duplicate and null values.
- Vector follows insertion order.
- Vector is both homogeneous and heterogeneous.
- The initial capacity of vector is 10 continuous memory blocks.
- The auto-growable capacity of vector is half of its previous capacity + 1.

Sytaxt:

```
Vector vector = new Vector();
```

Exa :

```
import java.util.Vector;
public class VectorExample {
    public static void main(String[] args) {
        // Create a Vector to store strings
        Vector<String> names = new Vector<>();
        // Add elements to the Vector
        names.add("Alice");
        names.add("Bob");
        names.add("Charlie");
        // Iterating through the Vector using a for-each loop
        for (String name : names) {
            System.out.println(name);
        }
    }
```

Queue

- Queue is a sub-interface of the Collection interface.
- It was introduced in the version of JDK 1.2.
- It is present in the java.util package.
- Queue interface having one predefined implementation class.

Common qualities of Queue interface:

- Queue is not index-based.
- Queue allows duplicate values.
- Queue does not allow null values.

PriorityQueue

- PriorityQueue is a predefined implementation class of the Queue interface.
- It was introduced in the version of JDK 1.5.
- PriorityQueue is not index-based.
- It is present in the java.util package.
- It allows duplicate values.
- It does not allow null values.
- If the programmer tries to store a null value, that time null value will get a NullPointerException.
- PriorityQueue is only homogeneous. If we try to store different data types, we will get a ClassCastException.

Priority queue having two predefined own methods:

1. peek(): Object

➢ it is non-static method present in PriorityQueue, peek() is used to return/retrieve/get the head element from the collection.

2. poll(): Object

➢ it is non-static method present in PriorityQueue, poll() first it will retrieve the head object and permanently remove it from the collection.

Exa :

```
import java.util.PriorityQueue;
public class PriorityQueueExample {
   public static void main(String[] args) {
// Create a PriorityQueue 1  to store integers
        PriorityQueue<Integer> pq = new PriorityQueue<>();
 // Add elements to the PriorityQueue
        pq.add(10);
        pq.add(5);
        pq.add(15);
        pq.add(2);
        pq.add(8);
```

```
// Printing the PriorityQueue
        System.out.println("PriorityQueue: " + pq);
// Retrieving the minimum element without removing it
        int minElement = pq.peek();
       System.out.println("Minimum element: " + minElement);
// Removing and returning the minimum element
        int removedElement = pq.poll();
        System.out.println("Removed minimum element: " +
        removedElement);
// Printing the PriorityQueue after removal
       System.out.println("PriorityQueue after removal: " + pq);
    }
}
```

Is it possible to keep other statements between the try and catch block and finally block?

- No, we cannot able to write code between the try-catch and finally blocks.

Can we keep other statements between the try and catch block and finally block?

- No, we cannot able to write code between the try-catch and finally blocks. They are mutually coupled.

Why do you use the throws keyword in Java?

- To propagate exceptions from a called method to a caller method, we use the throws keyword in Java.

Set:

- Set is a predefined subinterface of the Collection interface.
- It was introduced in the version of JDK 1.2.
- It is present in the java.util package.
- Set having four implementation classes:
  1. HashSet
  2. LinkedHashSet
  3. TreeSet
  4. ConcurrentHashMap.keySet()

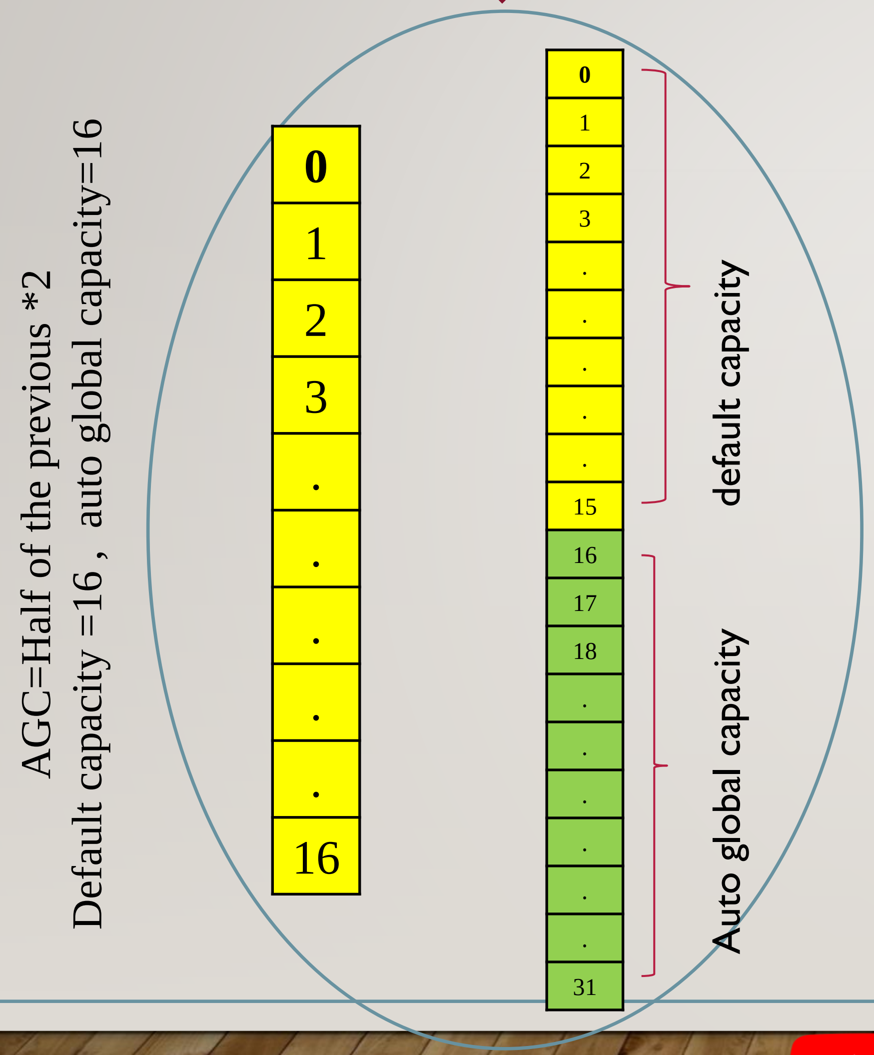
Common qualities of Set interface:

- Set is not index-based.
- Set does not allow duplicate values.

HashSet

- HashSet is a predefined implementation class of the Set interface.
- It was introduced in the version of JDK 1.2.
- It is present in the java.util package.
- HashSet is not index-based.
- HashSet does not allow duplicate values.
- HashSet allows null value.
- HashSet is both homogeneous and heterogeneous.
- HashSet does not follow insertion order, but internally it follows hashing technique order.
- Initial capacity of HashSet is 16 continuous memory blocks.
- The fill ratio threshold value is 75%, which means whenever 12 memory blocks are filled, it will auto-grow half of its previous capacity.
- It will not wait until all memory blocks are filled.

HashSet arraylist = new HashSet();



Exa :

```
import java.util.HashSet;
public class HashSetExample {
    public static void main(String[] args) {
        // Create a HashSet to store strings
        HashSet<String> names = new HashSet<>();
        // Add elements to the HashSet
        names.add("Alice");
        names.add("Bob");
        names.add("Charlie");
  names.add("Alice"); // Duplicate element, will not be added
        // Printing the HashSet
        System.out.println("HashSet: " + names);
    }
}
```

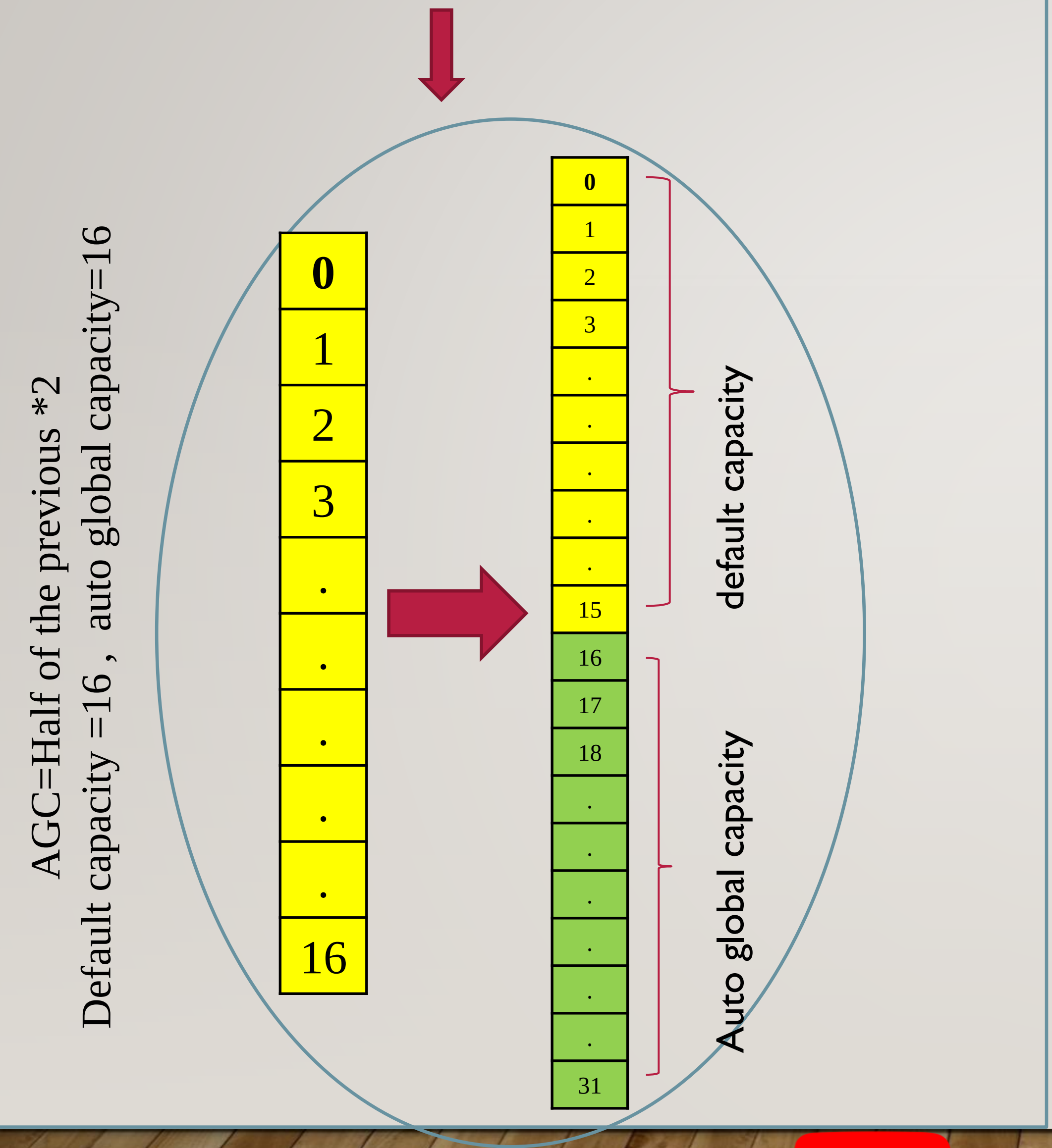
LinkedHashSet

- LinkedHashSet is a predefined implementation class of the Set interface.
- It was introduced in the version of JDK 1.4.
- It is present in the java.util package.
- LinkedHashSet is not index-based.
- It does not allow duplicate values.
- It allows null value.
- LinkedHashSet is both homogeneous and heterogeneous.
- LinkedHashSet follows insertion order.
- The initial capacity of LinkedHashSet is 16 continuous memory blocks.
- The fill ratio threshold value is 75%.
- It will auto-grow half of its previous capacity*2.

Exm : retrive common element from 2 collection and store in 3rd collection?

```
package LinkedHashSet;
import java.util.LinkedHashSet;
public class PrintCommonObject {
    public static void main(String[] args) {
        LinkedHashSet<Integer> 11 = new LinkedHashSet<>();
        // ... (add elements to 11)
        LinkedHashSet<Integer> 12 = new LinkedHashSet<>();
 // Find common elements and store them
        LinkedHashSet<Integer> commonElements = new
         LinkedHashSet<>(11);
        commonElements.retainAll(12);
        // Print the common elements
        System.out.println("Common elements: " +
commonElements);
    }}
```

`LinkedHashSet arraylist = new LinkedHashSet ();`



Can we throw exception manually/explicitly?

- Yes, we can throw an exception by using the throw keyword. It will throw the exception called method to the caller method.

Are we allowed to use only a try block without a catch block and finally block?

- No, because both catch and try blocks are mutually combined. Without a catch block, how will you know which exception he needs to handle? You will get confused, hence must await with a try-catch block.

Is a finally block always executed in a Java program?

- Yes, a finally block gets executed in every condition irrespective of checking of conditions (abnormal or normal).

What will happen if an exception is thrown by the main method?

- We can able to throw an exception from the main method to the caller method by using the throws keyword.

TreeSet:

- TreeSet is a predefined implementation class of the Set interface.
- It was introduced in JDK 1.2.
- It is present in the java.util package.
- It is *not* index-based (meaning you can't access elements by index like in an array or list).
- It does *not* allow duplicate values. If you try to add a duplicate, it's ignored.
- It does *not* allow null values. If you try to store null, you'll get a NullPointerException.
- TreeSet is *only homogeneous*. If a programmer tries to store heterogeneous (different types) objects, a ClassCastException will be thrown.
- TreeSet does *not* follow insertion order because internally it follows *sorting order*.
- When we try to add an object, it instantly sorts.

Exa:

```
package set;
import java.util.TreeSet;

public class TreeSet {
    public static void main(String[] args) {
        TreeSet<Integer> t = new TreeSet<Integer>();
        t.add(6);
        t.add(3);
        t.add(8);
        t.add(5);
        t.add(1);
        t.add(7);
        t.add(11);
        t.add(9);
        t.add(13);
        System.out.println(t);
    }
}
```

Diff b/w List vector and set implementation classes ?

	List (Interface)			**Queue**	**Set (Interface)**		
Feature	ArrayList	LinkedList	Vector	PriorityQueue	HashSet	LinkedHashSet	TreeSet
Introduced	JDK 1.2	JDK 1.2	JDK 1.0 (Legacy)	JDK 1.5	JDK 1.2	JDK 1.4	JDK 1.2
Insertion Order	Follows	Follows	Follows	Follows minimum heap order (Parent-Child)	Not followed (Hashing order)	Follows insertion order	Not followed (Sorting order)
Index-based	Index-based	Index-based	Index-based	Not index-based	Not index-based	Not index-based	Not index-based
Duplicate Values	Allowed	Allowed	Allowed	Not allowed	Not allowed	Not allowed	Not allowed
Null Values	Allowed	Allowed	Allowed	Not allowed	Not allowed	Allows one null value	Not allowed
Initial Capacity	10 continuous memory blocks	No initial capacity	10 continuous memory blocks	No initial capacity	16 continuous memory blocks	16 continuous memory blocks	No fixed capacity

Feature	ArrayList	LinkedList	Vector	PriorityQueue	HashSet	LinkedHashSet	TreeSet
Homogeneous/Heterogeneous	Homogeneous / Heterogeneous	Homogeneous / Heterogeneous	Homogeneous / Heterogeneous	Homogeneous	Homogeneous / Heterogeneous	Homogeneous / Heterogeneous	Homogeneous
Auto-grow capacity	Half of previous capacity + 1	No auto-growth	Half of previous capacity + 1	No auto-growth capacity	Half of previous capacity + 1	Half of previous capacity + 1	Don't have
Fill ratio	100%	Does not have	100%	Does not have	75%	75%	Don't have
Thread-safe	Not thread-safe	Not thread-safe	Thread-safe	Not thread-safe	Not thread-safe	Not thread-safe	Not thread-safe
Time complexity to add an element	O(1)	O(1)	O(1)	O(log n)	O(1)	O(1)	O(log n)
Time complexity to get an element by index	O(1)	O(n)	O(1)	Not applicable	Not applicable	Not applicable	Not applicable

Cursor

- What is the purpose of cursor?
  - The purpose of cursor is to retrieve/return the object one by one from the collection.
- What is cursor?
  - Cursor is nothing but traversing.
  - Traversing means cursor should move from one object to another object.
- In Java we have 3 predefined cursors:
  - Iterator
  - ListIterator
  - Enumeration

Collection	Iterator	ListIterator	Enumeration
ArrayList	✓	✓	X
LinkedList	✓	✓	X
Vector	✓	✓	✓
PriorityQueue	✓	X	X
HashSet	✓	X	X
LinkedHashSet	✓	X	X
TreeSet	✓	X	X

Iterator

- Iterator is a predefined interface in java.
- It is present in the java.util package.
- It was introduced in the version of JDK 1.2.
- Iterator cursor is also called as universal cursor, because it is applicable to all type of collection.
- Iterator cursor travels only in forward direction, that means it will retrieve only forward object

Iterator having 3 predefined methods:

1. **next(): Object**
2. **hasNext(): boolean**
3. **remove(): void**

Exa :

```
import java.util.ArrayList;
import java.util.Iterator;
public class IteratorExample {
    public static void main(String[] args) {
        // Create an ArrayList to store strings
        ArrayList<String> names = new ArrayList<>();
        names.add("Alice");
        names.add("Bob");
        names.add("Charlie");
        // Get an iterator for the ArrayList
        Iterator<String> iterator = names.iterator();
        // Iterate through the ArrayList using the iterator
while (iterator.hasNext()) {
            String name = iterator.next();
            System.out.println(name);
        }
        // Remove an element using the iterator
        iterator = names.iterator();
        while (iterator.hasNext()) {
            String name = iterator.next();
            if (name.equals("Bob")) {
                iterator.remove();
            }
        }
        System.out.println("ArrayList after removing Bob: " + names);
    }
}
```

ListIterator

- ListIterator is a predefined interface which is present in java.util package.
- It was introduced in the version of JDK 1.2.
- ListIterator travels both forward direction and backward direction.

ListIterator having 5 predefined methods:

1. **next(): Object**
2. **hasNext(): boolean**
3. **previous(): Object**
4. **hasPrevious(): boolean**
5. **remove(): void**
6. **add(): void**

Exa :

```
import java.util.ArrayList;
import java.util.ListIterator;
public class ListIteratorExample {
public static void main(String[] args) {
// Create an ArrayList 1  to store strings
       ArrayList<String> names = new ArrayList<>();
      names.add("Alice");
       names.add("Bob");
       names.add("Charlie");
       names.add("David");
// Get a ListIterator for the ArrayList
       ListIterator<String> iterator = names.listIterator();
       // Iterate forward
       while (iterator.hasNext()) {
           String name = iterator.next();
           System.out.println(name);
       }
       System.out.println();
```

```
// Iterate backward
        while (iterator.hasPrevious()) {
            String name = iterator.previous();
            System.out.println(name);
        }
        // Add an element at the beginning
        iterator.add("Eve");
        System.out.println("ArrayList after adding Eve: " + names);
        // Remove an element
        iterator.next(); // Move to the next element (Bob)
        iterator.remove();
        System.out.println("ArrayList after removing Bob: " + names);
    }
}
```

Enumeration/Legacy Cursor

- Enumeration is a predefined interface which is present in java.util package.
- It was introduced in the version of JDK 1.0.
- Enumeration is also called as legacy cursor.
- Enumeration travels only forward direction.

Disadvantage

- In Enumeration, we cannot remove the object because we don't have a remove method in the Enumeration interface.

Enumeration having two predefined methods:

1. nextElement(): Object
2. hasMoreElements(): Boolean

Exa :

```
import java.util.Enumeration;
import java.util.Vector;
public class EnumerationExample {
    public static void main(String[] args) {
        // Create a Vector 1  to store strings
        Vector<String> names = new Vector<>();
        names.add("Alice");
        names.add("Bob");
        names.add("Charlie");
        // Get an Enumeration for the Vector
        Enumeration<String> enumeration = names.elements();
        // Iterate through the Vector using the Enumeration
        while (enumeration.hasMoreElements()) {
            String name = enumeration.nextElement();
            System.out.println(name);
        }}}
```

java.lang Package:

- Object class, Object, String, System, Exception, RuntimeException, Double, Integer

java.util Package:

- Collection<E>, List<E>, ArrayList<E>, LinkedList<E>, Queue

Arrays

- File, InputStream, OutputStream, Reader, Writer, FileInput Stream, FileOutputStream

Difference between length() and length variable:

- length() is used to find the length of a String. It is a method, so it requires parentheses () and is not applicable for arrays.
- length variable is used to find the length of an array.
- In Java, array size is constant. After declaration time, we cannot change the array size throughout the program. (Java arrays are fixed)

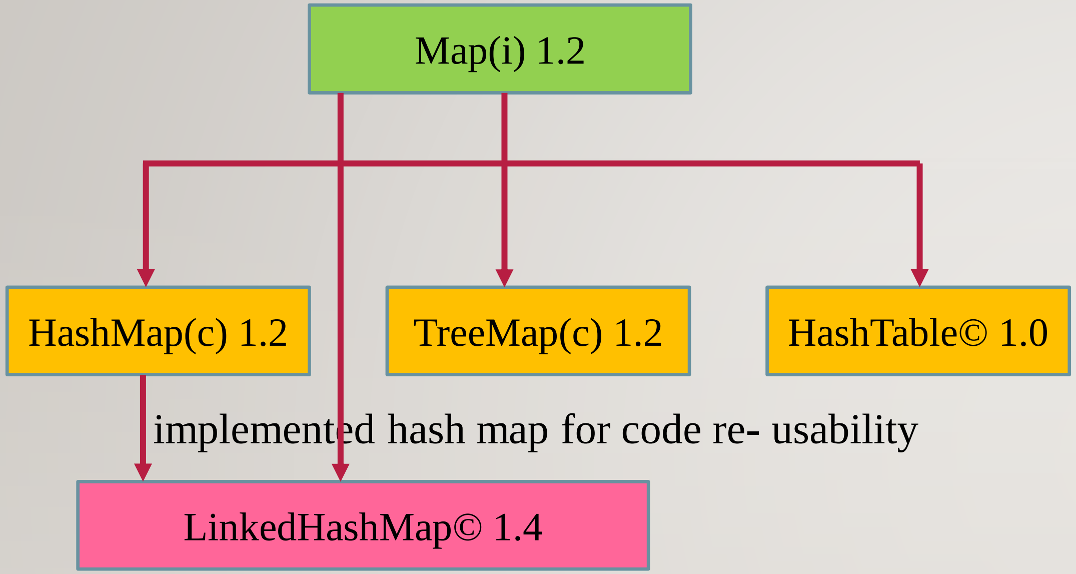
Diff b/w Iterator, ListIterator and Enumeration ?

Feature	Iterator	ListIterator	Enumeration
Working with	Various collections like List, Set, etc.	Works with List only	Works with legacy collections (Vector)
Direction	Forward only	Bidirectional	Forward only
Modification	Can modify the collection	Can modify the list	Cannot modify the collection
Superclass	None	Iterator	None
Operations	next(), hasNext(), remove()	next(), hasNext(), previous(), hasPrevious(), add(), remove()	nextElement(), hasMoreElements()
Purpose	General purpose iterator	List-specific bidirectional access	Legacy code, read-only
Introduced	JDK 1.2	JDK 1.2	JDK 1.0 (legacy cursor)

Diff b/w final, finally and finalize()?

Feature	final	finally	finalize()
Purpose	To make something unchangeable	To ensure code execution	To de-rerefer all object before garbage collection
Usage	For classes, methods, and variables	In try-catch-finally blocks	Invoked by the garbage collector
Syntax	final int a = 10; public final class A {}	try { // code } catch (Exception e) { // handle exception } finally { // code to be executed always }	protected void finalize() throws Throwable {}

Hierarchy of map Interface :



Map Object

- In collections, we can store only one object at a time. To overcome this limitation, we are going for Map Object.
- Map is an interface which is having 3 implementation classes.
    1. **HashMap**
    2. **LinkedHashMap**
    3. **TreeMap**

Map Object will be containing object in the form of key and value.

- Key should not be duplicated and value can be duplicated.
- Each key and value pair are known as entry object.
- Because of this reason Map Object is also known as collection of entry objects.
- Whenever we want to store a single object, go with collection, whenever we want to store in the form of key and value pair at that time make use of Map Object.

Map Interface Methods:

1. put(KeyObject, ValueObject): ValueObject

- This method is used for adding the element inside the Map Object.
- This method is taking two inputs in the form of key and value.
- If we print this method, the mapped value will be printed.

2. containsKey(KeyObject): boolean

- This method will be checking whether the given key object is present or not.
- If the given key is present, this method will be returning true, if not, this method will be returning false.

3. remove(KeyObject): ValueObject

- This method will be removing the given key.

4. containsValue(ValueObject): boolean

- This method will be checking whether the given value is present or not.
- If the given value is present, this method will return true; if not, this method will return false.

5. keySet(): Set<K>`

- Returns a Set view of the keys contained in this map.
- The set is backed by the map, so changes to the map are reflected in the set, and vice-versa.

6. values(): Collection<V>`

- Returns a Collection view of the values contained in this map.
- The collection is backed by the map, so changes to the map are reflected in the collection, and vice-versa.

7. replace(K key, V oldValue, V newValue): boolean

- Replaces the value associated with the specified key with the given value only if the current value associated with the key is equal to the given old Value.
- Returns true if the value was replaced, false otherwise.

8. entrySet(): Set<Map.Entry<K,V>>

- Returns a Set view of the mappings contained in this map.

- Each element in the set is a Map.Entry, which represents a key-value pair.
- The set is backed by the map, so changes to the map are reflected in the set, and vice-versa.

Entry Interface contains 3 methods which is used for performing separately on key and separately on values, the methods are as follow:

1. **getKey(): Key**
2. **getValue(): Value**
3. **setValue(newValue): void**

Note:

This three method are based on cursor. It is always give cursor pointing value on key.

HashMap :

- HashMap is an inbuilt class and implementation class of the Map interface.
- We can create HashMapObject in 4 ways:
  1. **HashMap()**
  2. **HashMap(int initialCapacity)**
  3. **HashMap(int initialCapacity, float loadFactor)**
  4. **HashMap(Map<K,V> m)**
- If we give initial capacity less than 0, it will give an exception.

Characteristics of HashMap

- HashMap will be taking objects in the form of key and value.
- Key should not be duplicated, but value can be duplicated.
- One null key is allowed, multiple null values are allowed.
- The data structure of HashMap is Hashtable.
- The output order of HashMap will be in the form of Hashing Technique order.

Exa :

```java
public class HashMapExample {
    public static void main(String[] args) {
        // Create a HashMap to store key-value pairs
        HashMap<String, Integer> ages = new HashMap<>();
        // Add key-value pairs to the HashMap
        ages.put("Alice", 25);
        ages.put("Bob", 30);
        ages.put("Charlie", 28);
        ages.put("David", 30); // Duplicate value is allowed
        // Accessing values
        int aliceAge = ages.get("Alice");
        System.out.println("Alice's age: " + aliceAge);
        // Checking if a key exists
        boolean containsBob = ages.containsKey("Bob");
        System.out.println("Does the HashMap contain Bob? " + containsBob);
        // Removing a key-value pair
        ages.remove("Charlie");
        System.out.println("HashMap after removing Charlie: " + ages);
        // Getting all keys
        System.out.println("Keys: " + ages.keySet());
        // Getting all values
        System.out.println("Values: " + ages.values());
    }
}
```

#LinkedHashMap

- LinkedHashMap is an implementation class of the Map interface.
- At the same time, it inherits the HashMap class for code reusability.
- It was introduced in JDK version 1.4.
- In LinkedHashMap, we can store keys and values, but keys should not be duplicated. Values can be duplicated.
- The data structure of LinkedHashMap is a HashTable + LinkedList implementation. Because of the internal key linkages created, the output order will be in the form of insertion order.
- Whenever we want to store keys and values, and we want to get the insertion order at that time, make use of LinkedHashMap objects.

Notes:-

- LinkedHashMap is inheriting HashMap to perform constructor chaining and code reusability.

Exa : import java.util.LinkedHashMap;

```
public class LinkedHashMapExample {
    public static void main(String[] args) {
        // Create a LinkedHashMap to store employee information
        LinkedHashMap<String, Employee> employees = new LinkedHashMap<>();
        // Create Employee objects
        Employee emp1 = new Employee("Alice", 30, "Software Engineer");
        Employee emp2 = new Employee("Bob", 25, "Data Scientist");
        Employee emp3 = new Employee("Charlie", 28, "Product Manager");
        // Add employees to the LinkedHashMap
        employees.put("Employee1", emp1);
        employees.put("Employee2", emp2);
        employees.put("Employee3", emp3);
```

```
// Iterate through the LinkedHashMap and print employee details
        for (String key : employees.keySet()) {
            Employee employee = employees.get(key);
            System.out.println("Employee ID: " + key);
            System.out.println("Name: " + employee.getName());
            System.out.println("Age: " + employee.getAge());
            System.out.println("Role: " + employee.getRole());
            System.out.println();
        }}
    static class Employee {
        private String name, role;
        private int age;
        public Employee(String name, int age, String role) {
            this.name = name;
            this.age = age;
            this.role = role;
        }
```

```java
public String getName() {
            return name;
        }
        public int getAge() {
            return age;
        }
        public String getRole() {
            return role;
        }
    }
}
```

TreeMap

- TreeMap is an implementation class of the Map interface.
- It was introduced in the JDK version of 1.2.
- TreeMap will store objects in the form of key and value.
- Key should not be duplicated, but value can be duplicated.
- The data structure of TreeMap is Red-Black Tree.
- Red-Black Sorting is nothing but keys will be sorted according to the sorted key all the values are getting placed.
- The output order of TreeMap will be in the form of sorting order.

HashTable

- According to data structure, it is a table which contains key and value.
- According to Map interface, Hashtable is an implementation class of Map Interface which was introduced in JDK 1.0.
- Because it was introduced in 1.0, it is also known as a legacy class in Map Interface.

Exa :

```
import java.util.TreeMap;
public class TreeMapExample {
    public static void main(String[] args) {
        // Create a TreeMap to store key-value pairs 1
        TreeMap<String, Integer> ages = new TreeMap<>();
        // Add key-value pairs to the TreeMap
        ages.put("Alice", 25);
        ages.put("Bob", 30);
        ages.put("Charlie", 28);
        ages.put("David", 30); // Duplicate value is allowed
        // Printing the TreeMap
        System.out.println("TreeMap: " + ages);
    }
}
```

Diff b/w HashMap, LinkedHashMap and TreeMap?

Feature	HashMap	LinkedHashMap	TreeMap
Order of Elements	No specific order (hash-based)	Insertion order	Sorting ordering of keys
Null Keys and Values	Allows one null key and multiple null values	Allows one null key and multiple null values	Does not allow null keys
Performance	Generally faster for retrieval and insertion	Slower than HashMap, but faster than TreeMap	Slower than HashMap and LinkedHashMap, but maintains sorted order
Use Cases	When order doesn't matter and performance is critical	When insertion order needs to be preserved	When elements need to be sorted based on keys

Diff b/w List and Map?

Feature	List	Map
Data Structure	Stores elements in a object.	Stores data in key-value object pairs
Duplicate Elements	Allows duplicate elements	Does not allow duplicate keys, but allows duplicate values
Null Elements	Allows multiple null elements	Allows at most one null key and any number of null values
Access	Elements are accessed by index	Elements are accessed by key
Implementation Classes	ArrayList, LinkedList, Vector	HashMap, TreeMap, LinkedHashMap, Hashtable

Thread

- Thread is actually a path which is given to JVM for execution purpose by the Thread Scheduler.
- Thread scheduler is the 4th resource given by the Java Development Kit (JDK).
- According to java library, Thread is an inbuilt class which is present inside lang package, it was introduced in JDK version of 1.0.

Multi-Threading

- In two method, there is no relation or connection between two methods at that time go for multithreading.
- The process of creating Multiple Threads by using single thread is known as multithreading.

Purpose of Multithreading:

- To reduce the CPU time at the same time developer time
- Creation of videogames and animation
- Servers are built using Multithreading
- User Defined Thread Creation

Ways to Create a Thread:

1. Our Class Inheriting Thread Class

➢ Rules to create:

- Our class has to inherit Thread class to get the property of Thread class
- Override the run() method present in Thread class because whatever the logic provided inside run() will be executed inside our defined Thread or child Thread.

2. Our Class Implementing Runnable Interface

➢ Create a class, class will implements the Runnable interface and Implement the run() Method:

➢ Create a Thread object.

➢ For Start the Thread Call the start() method on the Thread object to initiate the execution of the run() method.

if we call start() again by using same child Thread object?

- It will throw IllegalThreadStateException.

Thread execution:

1) Thread creation 2) Thread execution 3) Thread Scheduler

Diff b/w Thread Class and Runnable Interface

Feature	Thread Class	Runnable Interface
Inheritance	Extends Thread class	Implements Runnable interface
Object Creation	Create a subclass of Thread	Create a class that implements Runnable and pass its object to a Thread constructor
Thread Start	Directly call the start() method on the thread object	Create a Thread object and call its start() method, passing the Runnable object as an argument
Multiple Inheritance	Cannot be used with multiple inheritance as Java doesn't support it	Can be used with multiple inheritance as interfaces can be implemented multiple times
Flexibility	Less flexible as you can only create one thread per class	More flexible as you can create multiple threads sharing the same Runnable object

Exa : By implementing RunableInterface

```
public class RunnableThreadExample {
    public static void main(String[] args) {
     MyRunnableThread thread = new MyRunnableThread();
        Thread t = new Thread(thread);
        t.start();
    }
    static class MyRunnableThread implements Runnable {
        public void run() {
            for (int i = 0; i < 5; i++) {
                System.out.println("Thread 1: " + i);
                try {
                    Thread.sleep(1000); // Sleep for 1 second
                } catch (InterruptedException e) {
                    e.printStackTrace();
                }}}}}
```

Exa : By inheriting thread class

```
public class ThreadClassExample extends Thread {
    public void run() {
        for (int i = 0; i < 5; i++) {
            System.out.println("Thread 2: " + i);
            try {
                Thread.sleep(1000); // Sleep for 1 second
            } catch (InterruptedException e) {
                e.printStackTrace();
            }}}
    public static void main(String[] args) {
    ThreadClassExample thread = new ThreadClassExample();
        thread.start();
    }
}
```

Thread Life Cycle

A thread in Java goes through several states during its lifetime:

Stage 1: New State

- When we create a thread object at that time newly thread is created.

Stage 2: Ready/Runnable

- When developer calls start() explicitly, this stage is runnable state.

Stage 3: Running

- When JVM calls the run() implicitly, this stage is running state.

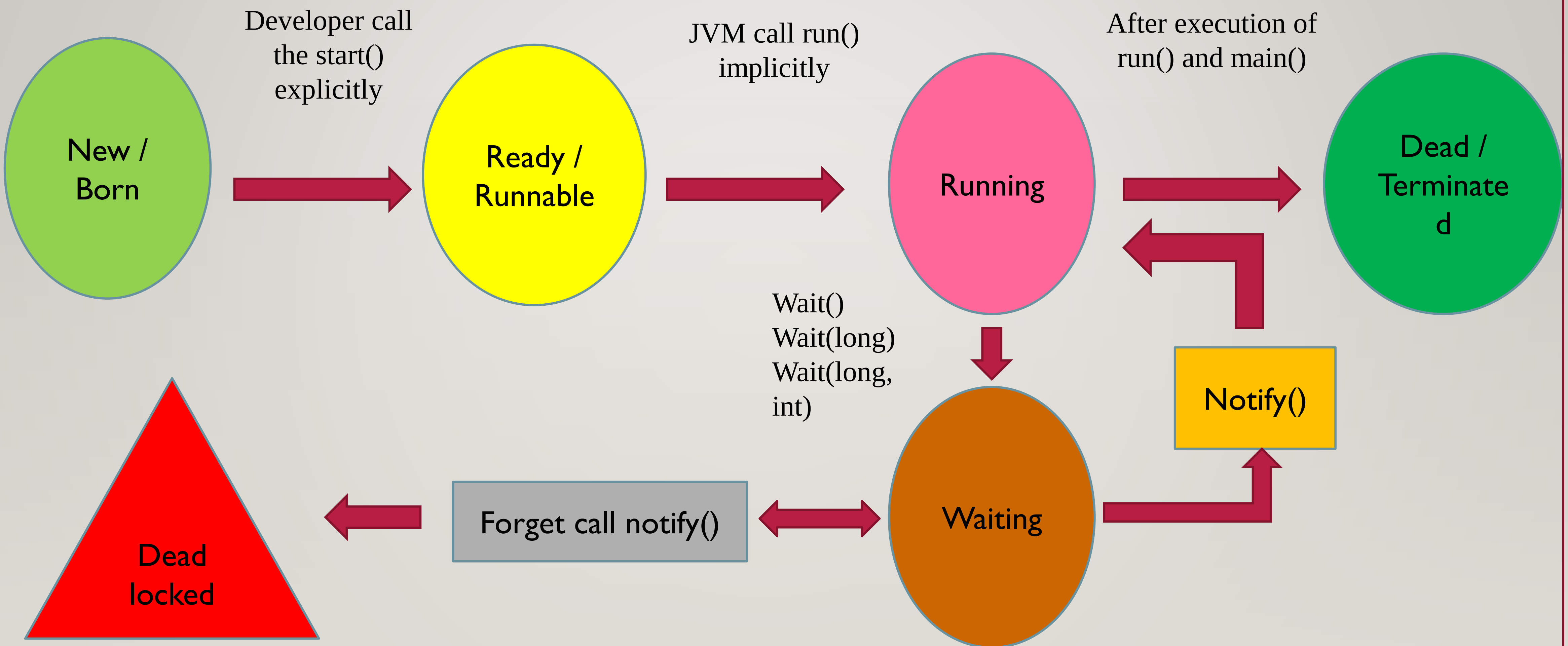
Stage 4: Waiting/dead-lock State

- When the developer calls the wait() method and the executing thread forgets to call notify(), at that time it will be in a dead-locked state, this process we are calling as deadlock situation.
- If the executing thread is calling the notify() method, then it will be going again back to the running stage.

Stage 5: Dead State:

- The thread has finished executing its task or has been terminated.
- It no longer exists in the system.

Thread life cycle :



Thread Property:

Every thread in this Java world has 2 properties:

1. **Name**
2. **Priority**

Thread Name:

- The default name given by the JVM is main for the main thread.
- The default name given by the JVM for user-defined threads is Thread-0, Thread-1, and so on.
- We can change the default name given by the JVM.
- Yes, we can modify/change the thread name using setName(String newName).
- By using getName(), we can retrieve the name which we have changed.

Inter-Thread Communication: (Multithreading)

- The process of making one thread to communicate with another thread is known as Inter-thread communication. Whenever we want one thread to communicate with another thread at that time we have to make use of inter-thread communication methods.
- There are 5 methods which are used for performing the communication in two threads:
  1. wait(): void
  2. wait(long milliseconds): void
  3. wait(long milliseconds, int nanos): void
  4. notify(): void
  5. notifyAll(): void

note :- all this method is present inside object class.

Thread Property :

void setName(String name)

- Sets the name of the thread to the specified name.

String getName()

- Returns the name of the thread.

void setPriority(int priority)

- Sets the priority of the thread. The priority is an integer between Thread.MIN_PRIORITY (1) and Thread.MAX_PRIORITY (10).

int getPriority()

- Returns the priority of the thread.

static Thread currentThread()

- Returns a reference to the currently executing thread.

Return :

(1) thread name
(2) thread priority
(3) Parent thread method name where it called.

Synchronization

- It is a process to make single thread to access single object in other words making an object thread-safe.
- Synchronization can be achieved by a keyword known as synchronized.
- synchronized keyword is applicable only for methods and it is not applicable for variables and constructors.

Exa :2

```
package Synchronization;
class Football {
 public synchronized void kickFootball(String playerName) {
        try {
            Thread.sleep(2000);
       System.out.println("Football came to " + playerName);
            Thread.sleep(2000);
 System.out.println(playerName + " is kicking the Football");
        } catch (InterruptedException e) {
            e.printStackTrace();
        }
   }}
 public class Player extends Thread {
    private String playerName;
    private Football footballObject;
public Player(String playerName, Football footballObject) {
        this.playerName = playerName;
        this.footballObject = footballObject;
    }
    public void run() {
        footballObject.kickFootball(playerName);
    }
    public static void main(String[] args) {
        Football football = new Football();
        Player player1 = new Player("Messi", football);
        Player player2 = new Player("Ronaldo", football);
        player1.start();
        player2.start();
    }
}
```

Advantages and Disadvantages of Synchronization?

Feature	Advantages	Disadvantages
Thread Safety	Only one thread can access a at a time it will insure.	Can lead to performance degradation due to context thread sape.
Consistency	shared data remains consistent across multiple threads.	Can introduce performance highly concurrent applications.
Deadlock Prevention	Can be used to prevent deadlocks if implemented carefully.	Improper use of synchronization can lead to deadlocks.
Simplicity	Relatively simple to implement using the synchronized keyword.	Can be complex to use in more intricate scenarios, requiring careful consideration of locking mechanisms.

Diff B/W wait method and sleep method?

Feature	sleep()	wait()
Class	Thread	Object
Purpose	Pauses the current thread stop execution for a specified duration.	Pauses the current thread stop execution and releases the lock on the object.
Lock	Does not release the lock on any object.	Releases the lock on the object that the notify() method was called on.
Usage	Primarily used for pausing the thread execution for a specific time, such as for implementing delays.	Primarily used for thread synchronization and communication between threads.
Example	Thread.sleep(1000); (pauses for 1 second)	object.wait(); (pauses till the notify)

Explanation of printing o/p in java

- **System**: This is a final class in the java.lang package. It provides access to system properties and environment variables.
- **out**: This is a public static field of the System class. It's an instance of the PrintStream class, which is used for writing text to an output stream, typically the console.
- **println()**: This is a method of the PrintStream class. It takes an argument, converts it to a string, and prints it to the standard output stream (usually the console). After printing, it adds a newline character, hence the name "println" (print line).

Exa :

```
package User;
import Lang.SystemLocal;
public class User {
public static void main(String[] args){
        SystemLocal.outLocal.printlnLocal("hii");
}}
package Lang;
import IO.PrintStreamLocal;
public class SystemLocal {
        public static final PrintStreamLocal     outLocal=new
PrintStreamLocal();
}
package IO;
public class PrintStreamLocal {
public void printlnLocal(String message) {
        System.out.println(message);
}}
```

Java Bin Class

- the classes with contain getter and setter method those classes called bin class.
- All encapsulated programs are not JavaBin Class programs but all JavaBin Class programs are encapsulated.
- we can not only initialized the non-static variable by using method and by using constructor we can also use getters and setters() for initializing. non static variable

Condition to Create setter’s method :

- setters method should be public and nonstatic.
- it should have argument but it should not have return type
- this method is used for setting or modifying non-static variable.

Condition to create getters method:

- getters method should be public and non static.
- it should have return type but it should not have argument.
- it is use for fetching/getting/returning/retrieving non static variable.

```
public class Person implements Serializable {
    private String firstName;
    private int age;
    // Default constructor
    public Person() {
    }
    // Parameterized constructor
    public Person(String firstName, String lastName, int age) {
        this.firstName = firstName;
        this.age = age;
    }
    // Getters and setters
    public String getFirstName() {
        return firstName;
    }
```

```java
public void setFirstName(String firstName) {
        this.firstName = firstName;
    }
    public int getAge() {
        return age;
    }
    public void setAge(int age) {
        this.age = age;
    }
}
```

Garbage Collector :

- The process of automatically cleaning memory used by objects that are not needed is known as garbage collection.
- In older languages like C++, developers were responsible for both creating and destroying objects.
- To address this issue, modern languages like Java have implemented automatic garbage collection. The garbage collector periodically scans the heap for objects that are no longer and clean their memory.
- If object don't have reference those are eligible for garbage collection

There are several ways to make an object eligible for garbage collection:

1. **Nullifying the object:** Setting the reference to the object to null.
2. **Reassigning the object:** Assigning a new object to the same reference.
3. **Creating the object inside a method:** The object becomes eligible for garbage collection when the method returns.

Property of setter , getter way and constructor way of initialization ?

Method	Description	Advantages	Disadvantages
Constructor	Initializes instance variables during object creation.	Efficient, values are set at object creation.	Less flexible, values cannot be changed after object creation without creating a new object.
Setter Methods	Initializes or modifies instance variables after object creation.	Flexible, values can be changed dynamically.	More variable, requires multiple method calls.
Getter Methods	Retrieves the values of instance variables.	Provides access to private instance variables.	No direct initialization, primarily used for retrieval.

Enum :

Enum is a keyword used for creating a user-defined data type. While classes can also be used to create user-defined data types, using enums is more concise and efficient for representing a fixed set of values.
By using enums, we can create our own data types and represent a group of named constants.
Enums were introduced in Java in JDK version 1.5.

Characteristics of enum types:

1. Enum constants are implicitly public, static, and final.
2. To access enum constants from another class, use the class name.
3. When declaring enum constants, semicolons are optional after the last constant.

Exa :

```
public enum Day {
   MONDAY, TUESDAY, WEDNESDAY, THURSDAY, FRIDAY, SATURDAY, SUNDAY
}
public class EnumExample {
   public static void main(String[] args) {
      Day today = Day.MONDAY;
      if (today == Day.MONDAY) {
         System.out.println("It's Monday!");
      }
      // Iterate over all enum values
      for (Day day : Day.values()) {
         System.out.println(day);
      }
   }
}
```

Default Method

- Default methods were introduced in Java 8.
- If a new method is added to an interface, all implementing classes must be updated to provide an implementation for the new method.
- To avoid this breaking change, we can use default methods.
- Default methods can only be declared within interfaces, not classes.
- Subclasses that implement an interface with a default method are not required to provide their own implementation.

Exa :

```
interface Shape {
   void area();
   default void draw() {
      System.out.println("Drawing a shape");
   }}
class Circle implements Shape {
   @Override
   public void area() {
      // Implementation for calculating the area of a circle
   }}
class Rectangle implements Shape {
   @Override
   public void area() {
      // Implementation for calculating the area of a rectangle
   }}
```

File Handling :

File:

A file is a storage medium where we can store various types of data, such as audio, video, text documents, code, and more.

Why File Handling?

- **Data Persistence:** Local variables and objects in memory are temporary and lost when the program or method ends.
- **Data Protection:** To ensure data is preserved beyond the program's execution, we store it in files.
- **Data Management:** File handling allows us to perform operations like reading, writing, updating, and deleting data from files.

Streams:

A stream is a sequence of data that flows from one place to another.

Java provides three standard streams:

1. **System.in:** Represents the standard input stream, typically the keyboard.
2. **System.out:** Represents the standard output stream, typically the console.
3. **System.err:** Represents the standard error stream, also typically the console.

In order to create streams, we need to use the following classes:

1. **File:** Represents a file or directory in the file system.
2. **FileInputStream:** Reads bytes from a file.
3. **FileOutputStream:** Writes bytes to a file.
4. **BufferedInputStream:** Reads bytes from a file with buffering for improved performance.
5. **BufferedOutputStream:** Writes bytes to a file with buffering for improved performance.
6. **ObjectInputStream:** Reads serialized objects from a file.
7. **ObjectOutputStream:** Writes serialized objects to a file.
8. **FileReader:** Reads characters from a file.
9. **FileWriter:** Writes characters to a file.

File Creation:

- To create a new file, we use the createNewFile() method, which is non-static and returns a boolean value. This method is part of the File class.
- To access this method, we first create a File object and provide the desired file name with its extension in the constructor.
- The createNewFile() method can throw an IOException. It's our responsibility to handle this exception using a try-catch block.
- The method returns true if the file is created successfully, otherwise, it returns false.

Exa :

```
File textFile = new File("TextFile.txt");


try {
    boolean isCreated = textFile.createNewFile();
    if (isCreated) {
        System.out.println("File created successfully");
    } else {
        System.out.println("File already exists");
    }
} catch (IOException e) {
    e.printStackTrace();
}
```

File Writing :

- To write to a file, we first need to create the file.
- After creating the file, we use the write() method, which is non-static and overloaded. This method is part of the FileWriter class.
- To access the write() method, we create a FileWriter object, passing either a File object or a file name as a parameter.
- Along with the write() method, we should use the flush() and close() methods. flush() pushes the data to the underlying storage, and close() releases the resources associated with the stream. Both methods are part of the OutputStreamWriter class.

Exa :

```
File demoFile = new File("Demo.txt");
    try {
        if (demoFile.createNewFile()) {
            System.out.println("File created successfully");
            FileWriter writer = new FileWriter(demoFile);
            writer.write("Hello, world!");
            writer.flush();
            writer.close();
        }
    } catch (IOException e) {
        e.printStackTrace();
    }
```

Reading from a File:

- To read from a file, we use the `read()` method, which is part of the `FileReader` class. This class inherits from `InputStreamReader`.
- The `read()` method reads a single character at a time. To read multiple characters, we typically use loops and conditional checks.
- If the character is present in the file, the `read()` method returns the character's ASCII value. If the end of the file is reached, the `read()` method returns -1.

Exa :

```
try{
        File demoFile = new File("Demo.txt");
        FileReader reader = new FileReader(demoFile);
        int character;
        while ((character = reader.read()) != -1) {
          System.out.print((char) character);
        }
     } catch (IOException e) {
        e.printStackTrace();
     }
```

Exa : File creation, write and read code

```
import java.io.*;
public class FileOperations {
    public static void main(String[] args) {
        String fileName = "example.txt";
      // Create a new file
        File file = new File(fileName);
        try {
            file.createNewFile();
        // Write to the file
            FileWriter writer = new FileWriter(file);
            writer.write("This is a line of text.\n");
            writer.write("This is another line.\n");
            System.out.println("File written successfully.");
        // Read from the file
FileReader reader = new FileReader(file);
            int character;
            while ((character = reader.read()) != -1) {
                System.out.print((char) character);
            }
        } catch (IOException e) {
            e.printStackTrace();
        }
    }
}
```

Stream API

The Stream API in Java provides a way to process collections of objects in a functional style. It allows you to perform operations like filtering, mapping, and reducing on collections and prowide efficient way .

Important Stream Operations

Filter

Definition: The filter() operation selects elements from a stream that satisfy a given condition (predicate).

Example (Java):

```
import java.util.Arrays;
import java.util.List;
import java.util.stream.Collectors;
```

```
public class FilterExample {
    public static void main(String[] args) {
        List<Integer> numbers = Arrays.asList(1, 2, 3, 4, 5, 6, 7, 8, 9, 10);

        List<Integer> evenNumbers = numbers.stream()
            .filter(n -> n % 2 == 0)
// Keep only even numbers
            .collect(Collectors.toList());

        System.out.println(evenNumbers);
// Output: [2, 4, 6, 8, 10]
    }
}
```

2. Map

- **Definition:** The map() operation transforms each element in a stream into a new element using a given function.
- If we have to apply operation on each element then go with map for **Example :**

```
import java.util.Arrays;
import java.util.List;
import java.util.stream.Collectors;
public class MapExample {
 public static void main(String[] args) {
 List<String> words = Arrays.asList("hello", "world", "java");
      List<Integer> wordLengths = words.stream()
     .map(String::length) // Transform each word to its length
           .collect(Collectors.toList());
      System.out.println(wordLengths); // Output: [5, 5, 4]
  }}
```

3. Reduce

- **Definition:** The reduce() operation combines all elements in a stream into a single result using a given function.
- reduce() is combines the elements of the stream into a single result. Here a is always resultant value ititialy it should be 0.
- **Example (Java):**

```
import java.util.Arrays;
import java.util.List;
public class ReduceExample {
   public static void main(String[] args) {
      List<Integer> numbers = Arrays.asList(1, 2, 3, 4, 5);
      int sum = numbers.stream()
             .reduce(0, (a, b) -> a + b);  // Cal. sum of all numbers
      System.out.println(sum); // Output: 15
   }}
```

4. Distinct

- Definition: The distinct() operation returns a stream with duplicate elements removed.
- Example (Java):

```
import java.util.Arrays;
import java.util.List;
import java.util.stream.Collectors;
public class DistinctExample {
    public static void main(String[] args) {
        List<Integer> numbers = Arrays.asList(1, 2, 2, 3,3, 4, 5);
        List<Integer> distinctNumbers = numbers.stream()
                .distinct() // Remove duplicate numbers
                .collect(Collectors.toList());
        System.out.println(distinctNumbers);
}}
```

5. Sorted

- **Definition:** The sorted() operation returns a stream with elements sorted in natural order or according to a custom comparator.
- **Example (Java):**

```
import java.util.Arrays;
import java.util.List;
import java.util.stream.Collectors;
public class SortedExample {
    public static void main(String[] args) {
        List<Integer> numbers = Arrays.asList(5, 2, 1, 4, 3);
        List<Integer> sortedNumbers = numbers.stream()
                .sorted() // Sort numbers in natural order
                .collect(Collectors.toList());
        System.out.println(sortedNumbers);
}}
```

6. ForEach

- **Definition:** The forEach() operation performs an action for each element in a stream.
- **Example (Java):**

```
import java.util.Arrays;
import java.util.List;
public class ForEachExample {
    public static void main(String[] args) {
        List<String> words = Arrays.asList("hello", "world");
        words.stream()
                .forEach(System.out::println); // Print each word
        // Output:
        // hello
        // world
    }}
```

7. Collect

- **Definition:** The collect() operation gathers the elements of a stream into a collection (e.g., List, Set, Map).
- **Example (Java):**

```
import java.util.Arrays;
import java.util.List;
import java.util.stream.Collectors;
public class CollectExample {
    public static void main(String[] args) {
        List<Integer> numbers = Arrays.asList(1, 2, 3, 4, 5);
        List<Integer> evenNumbers = numbers.stream()
                .filter(n -> n % 2 == 0)
                .collect(Collectors.toList()); // Collect even numbers
into a List
        System.out.println(evenNumbers); // Output: [2, 4]
    }}
```

8. flatMap

Definition: The flatMap() operation is used to flatten a stream of collections into a single stream. It takes a function that returns a stream for each element in the original stream, and then concatenates all the resulting streams into one **Example:**

```
import java.util.Arrays;
import java.util.List;
import java.util.stream.Collectors;
import java.util.stream.Stream;
public class FlatMapExample {
    public static void main(String[] args) {
        List<List<Integer>> listOfLists = Arrays.asList(
            Arrays.asList(1, 2, 3),
            Arrays.asList(4, 5),
            Arrays.asList(6, 7, 8, 9)
        );
```

```
List<Integer> numbers = listOfLists.stream()
            .flatMap(List::stream)
             .collect(Collectors.toList());
        System.out.println(numbers);
         // Output: [1, 2, 3, 4, 5, 6, 7, 8, 9]
        // Example with String arrays
        List<String[]> arrayOfArrays = Arrays.asList(
            new String[]{"hello", "world"},
            new String[]{"java", "streams"}
        );
        List<String> words = arrayOfArrays.stream()
            .flatMap(Arrays::stream)
            .collect(Collectors.toList());
        System.out.println(words); // Output: [hello, world, java,
streams]
   }}
```

9. findFirst

Definition: The findFirst() operation returns an Optional containing the first element of the stream, or an empty Optional if the stream is empty.

Example (Java):

```
import java.util.Arrays;

import java.util.List;

import java.util.Optional;


public class FindFirstExample {

    public static void main(String[] args) {

        List<Integer> numbers = Arrays.asList(1, 2, 3, 4, 5);


        Optional<Integer> firstEven = numbers.stream()

                .filter(n -> n % 2 == 0)

                .findFirst();

        System.out.println(firstEven.orElse(-1));

// Output: 2 (or -1 if no even number is found)


        List<Integer> emptyList = Arrays.asList();

        Optional<Integer> firstOfEmpty =
emptyList.stream().findFirst();

        System.out.println(firstOfEmpty.orElse(-1));

         // Output: -1

    }

}
```

10. findAny

- **Definition:** The findAny() operation returns an Optional containing any element of the stream. It's useful in parallel streams where finding the absolute first element might be computationally expensive, **Example :**

```
import java.util.Arrays;
import java.util.List;
import java.util.Optional;
public class FindAnyExample {
  public static void main(String[] args) {
    List<Integer> numbers = Arrays.asList(1, 2, 3, 4, 5);
    Optional<Integer> anyEven = numbers.stream()
        .filter(n -> n % 2 == 0)
        .findAny();
    System.out.println(anyEven.orElse(-1));
  }}
```

11. anyMatch

- **Definition:** The anyMatch() operation returns true if any element in the stream matches the given predicate, otherwise false, **Example :**

```
import java.util.Arrays;
import java.util.List;
public class AnyMatchExample {
  public static void main(String[] args) {
    List<Integer> numbers = Arrays.asList(1, 2, 3, 4, 5);
    boolean hasEven = numbers.stream()
        .anyMatch(n -> n % 2 == 0);
    System.out.println(hasEven); // Output: true
    boolean hasGreaterThan10 =
numbers.stream().anyMatch(n -> n > 10);
    System.out.println(hasGreaterThan10); // Output: false
  }}
```

12. allMatch

Definition: The allMatch() operation returns true if all elements in the stream match the given predicate, otherwise false, **Example in Java:**

```
import java.util.Arrays;
import java.util.List;
public class AllMatchExample {
    public static void main(String[] args) {
    List<Integer> numbers = Arrays.asList(2, 4, 6, 8, 10);
        boolean allEven = numbers.stream()
                .allMatch(n -> n % 2 == 0);
        System.out.println(allEven);
List<Integer> mixedNumbers = Arrays.asList(2, 3, 4, 6, 8, 10);
        boolean allEvenMixed =
mixedNumbers.stream().allMatch(n -> n % 2 == 0);
        System.out.println(allEvenMixed); // Output: false
    }}
```

13. noneMatch

Definition: The noneMatch() operation returns true if no elements in the stream match the given predicate, otherwise false, **Example :**

```
import java.util.Arrays;
import java.util.List;
public class NoneMatchExample {
    public static void main(String[] args) {
        List<Integer> numbers = Arrays.asList(1, 3, 5, 7, 9);
        boolean noEven = numbers.stream()
                .noneMatch(n -> n % 2 == 0);
        System.out.println(noEven); // Output: true
        List<Integer> mixedNumbers = Arrays.asList(1, 3, 4, 5, 7, 9);
        boolean noEvenMixed =
mixedNumbers.stream().noneMatch(n -> n % 2 == 0);
        System.out.println(noEvenMixed); // Output: false
    }}
```

13. count

- **Definition:** The count() operation returns the number of elements in the stream, **Example :**

```
import java.util.Arrays;
import java.util.List;
public class CountExample {
    public static void main(String[] args) {
      List<Integer> numbers = Arrays.asList(1, 2, 3, 4, 5);
        long evenCount = numbers.stream()
                .filter(n -> n % 2 == 0)
                .count();
        System.out.println(evenCount); // Output: 2
    }}
```

14. min and max

- **Definition:** The min() and max() operations return an Optional containing the minimum or maximum element in the stream according to a given comparator, **Example**

```
import java.util.Arrays;
import java.util.Comparator;
import java.util.List;
import java.util.Optional;
public class MinMaxExample {
    public static void main(String[] args) {
        List<Integer> numbers = Arrays.asList(5, 2, 1, 4, 3);
        Optional<Integer> min = numbers.stream()
                .min(Comparator.naturalOrder());
        System.out.println(min.orElse(-1)); // Output: 1
        Optional<Integer> max = numbers.stream()
                .max(Comparator.naturalOrder());
        System.out.println(max.orElse(-1)); // Output: 5
    }}
```

Arrays:

class provides static methods to manipulate arrays in Java. Here's a breakdown of the important methods with examples:

1. asList()

- Definition: Returns a fixed-size list backed by the specified array. Changes to the list will affect the array and vice-versa.
- Example:

```
import java.util.Arrays;

import java.util.List;

public class AsListExample {

    public static void main(String[] args) {

        String[] array = {"apple", "banana", "orange"};

        List<String> list = Arrays.asList(array);

        System.out.println(list); // Output: [apple, banana, orange]

        list.set(0, "grape"); // Modifying the list

        System.out.println(Arrays.toString(array)); // Output: [grape, banana, orange] (array is also changed)

        // list.add("kiwi"); // This will throw UnsupportedOperationException because the list is fixed-size.

    }

}
```

2. toString()

- **Definition:** Returns a string representation of the contents of the specified array.
- **Example:**

```
import java.util.Arrays;
public class ToStringExample {
    public static void main(String[] args) {
        int[] numbers = {1, 2, 3, 4, 5};
       System.out.println(Arrays.toString(numbers));
// Output: [1, 2, 3, 4, 5]
        String[] fruits = {"apple", "banana"};
        System.out.println(Arrays.toString(fruits));
// Output: [apple, banana]
    }
}
```

3. deepToString()

- **Definition:** Returns a string representation of the "deep contents" of the specified array. Use this for multidimensional arrays.
- **Example:**

```
import java.util.Arrays;
public class DeepToStringExample {
    public static void main(String[] args) {
        int[][] matrix = {{1, 2}, {3, 4, 5}};
        System.out.println(Arrays.deepToString(matrix));
            // Output: [[1, 2], [3, 4, 5]]
        String[][] names = {{"Mr.", "Smith"}, {"Ms.",
            "Jones"}};
        System.out.println(Arrays.deepToString(names));
            // Output: [[Mr., Smith], [Ms., Jones]]
    }}
```

4. equals() and deepEquals()

- **Definition:** equals() checks if two arrays are equal (same length and same elements in the same order). deepEquals() does the same for multidimensional arrays.
- **Example:**

```
import java.util.Arrays;

public class EqualsExample {
    public static void main(String[] args) {
        int[] arr1 = {1, 2, 3};
        int[] arr2 = {1, 2, 3};
        int[] arr3 = {3, 2, 1};
        int[] arr4 = {1, 2, 3, 4};

        System.out.println(Arrays.equals(arr1, arr2));
// Output: true
 System.out.println(Arrays.equals(arr1, arr3)); // Output: false
        System.out.println(Arrays.equals(arr1, arr4)); // Output: false

        int[][] matrix1 = {{1, 2}, {3, 4}};
        int[][] matrix2 = {{1, 2}, {3, 4}};
        int[][] matrix3 = {{1, 2}, {4, 3}};

        System.out.println(Arrays.deepEquals(matrix1, matrix2)); // Output: true
        System.out.println(Arrays.deepEquals(matrix1, matrix3)); // Output: false
    }
}
```

5. fill()

- **Definition:** Assigns the specified value to each element of the specified array.
- **Example:**

```
import java.util.Arrays;
public class FillExample {
    public static void main(String[] args) {
        int[] numbers = new int[5];
        Arrays.fill(numbers, 10);
        System.out.println(Arrays.toString(numbers));
// Output: [10, 10, 10, 10, 10]

    }
}
```

6. sort()

- **Definition:** Sorts the specified array into ascending order. There are overloaded versions for different data types and for sorting a range within the array, **Example:**

```
import java.util.Arrays;
public class SortExample {
    public static void main(String[] args) {
        int[] numbers = {5, 2, 8, 1, 9, 4};
        Arrays.sort(numbers);
        System.out.println(Arrays.toString(numbers));
            // Output: [1, 2, 4, 5, 8, 9]
        String[] fruits = {"orange", "apple", "banana"};
        Arrays.sort(fruits);
        System.out.println(Arrays.toString(fruits)); // Output:
[apple, banana, orange]
    }}
```

7. binarySearch()

- **Definition:** Searches for the specified value in the specified *sorted* array using the binary search algorithm. Returns the index of the search key, if it is contained in the array; otherwise, (-(insertion point) - 1).
- **Example:**

```
import java.util.Arrays;
public class BinarySearchExample {
    public static void main(String[] args) {
        int[] numbers = {1, 2, 4, 5, 8, 9}; // Must be sorted!
        int index = Arrays.binarySearch(numbers, 5);
        System.out.println(index); // Output: 3
        int notFound = Arrays.binarySearch(numbers, 6);
        System.out.println(notFound);
// Output: -5 (-(4+1) where 4 would be the insertion point)
        String[] fruits = {"apple", "banana", "orange"};
        int fruitIndex = Arrays.binarySearch(fruits, "banana");
// Must be sorted!
        System.out.println(fruitIndex); // Output: 1
    }
}
```

7. binarySearch()

- **Definition:** Searches for the specified value in the specified *sorted* array using the binary search algorithm. Returns the index of the search key, if it is contained in the array; otherwise, (-(insertion point) - 1).
- **Example:**

```
import java.util.Arrays;


public class BinarySearchExample {
    public static void main(String[] args) {
        int[] numbers = {1, 2, 4, 5, 8, 9}; // Must be sorted!
        int index = Arrays.binarySearch(numbers, 5);
        System.out.println(index); // Output: 3


        int notFound = Arrays.binarySearch(numbers, 6);
        System.out.println(notFound); // Output: -5 (-(4+1) where 4 would be the insertion point)


        String[] fruits = {"apple", "banana", "orange"};
        int fruitIndex = Arrays.binarySearch(fruits, "banana"); // Must be sorted!
        System.out.println(fruitIndex); // Output: 1
    }
}
```

8. copyOf() and copyOfRange()

- **Definition:** copyOf() creates a new array that is a copy of the specified array, truncating or padding with nulls (if needed) to obtain the specified length. copyOfRange() copies a specific range of the original array.
- **Example:**

```
import java.util.Arrays;


public class CopyOfExample {
    public static void main(String[] args) {
        int[] original = {1, 2, 3, 4, 5};
        int[] copy1 = Arrays.copyOf(original, 3); // Copy first 3 elements
        System.out.println(Arrays.toString(copy1)); // Output: [1, 2, 3]
        int[] copy2 = Arrays.copyOf(original, 7); // Pad with 0s
        System.out.println(Arrays.toString(copy2));
        // Output: [1, 2, 3, 4, 5, 0, 0]
        int[] copyRange = Arrays.copyOfRange(original, 1, 4);
        // Copy from index 1 (inclusive) to 4 (exclusive)
        System.out.println(Arrays.toString(copyRange));
        // Output: [2, 3, 4]
    }
}
```

Modifying Collections

- **addAll(Collection<? super T> c, T... elements):** Adds all of the specified elements to the specified collection.

```
import java.util.*;

public class AddAllExample {
    public static void main(String[] args) {
        List<String> list = new ArrayList<>();
        Collections.addAll(list, "apple", "banana",
"orange");
        System.out.println(list);
// Output: [apple, banana, orange]
    }
}
```

- **fill(List<? super T> list, T obj):** Replaces all of the elements of the specified list with the specified element.

```
import java.util.*;

public class FillExample {
    public static void main(String[] args) {
        List<String> list = new
ArrayList<>(Arrays.asList("a", "b", "c"));
        Collections.fill(list, "x");
        System.out.println(list); // Output: [x, x, x]
    }
}
```

copy(List<? super T> dest, List<? extends T> src): Copies all of the elements from one list into another. The destination list must be at least as long as the source list.

```
import java.util.*;
public class CopyExample {
    public static void main(String[] args) {
    List<String> src = Arrays.asList("apple", "banana");
        List<String> dest = new
ArrayList<>(Arrays.asList("1", "2", "3"));
// Destination must be large enough
        Collections.copy(dest, src);
     System.out.println(dest); // Output: [apple, banana, 3]
    }
}
```

- **swap(List<?> list, int i, int j):** Swaps the elements at the specified positions in the specified list.

```
import java.util.*;

public class SwapExample {
    public static void main(String[] args) {
        List<String> list = new
ArrayList<>(Arrays.asList("a", "b", "c"));
        Collections.swap(list, 0, 2);
        System.out.println(list); // Output: [c, b, a]
    }
}
```

- **reverse(List<?> list):** Reverses the order of the elements in the specified list.

```
import java.util.*;

public class ReverseExample {
    public static void main(String[] args) {
        List<String> list = new ArrayList<>(Arrays.asList("a", "b", "c"));
        Collections.reverse(list);
        System.out.println(list); // Output: [c, b, a]
    }
}
```

- **rotate(List<?> list, int distance):** Rotates the elements in the specified list by the specified distance.

```
import java.util.*;

public class RotateExample {
    public static void main(String[] args) {
        List<String> list = new ArrayList<>(Arrays.asList("a", "b", "c", "d", "e"));
        Collections.rotate(list, 2); // Rotate right by 2
        System.out.println(list); // Output: [d, e, a, b, c]
    }
}
```

shuffle(List<?> list): Randomly permutes the specified list using a default source of randomness.

shuffle(List<?> list, Random rnd): Randomly permutes the specified list using the specified source of randomness.

```
import java.util.*;

public class ShuffleExample {

    public static void main(String[] args) {

        List<Integer> list = new ArrayList<>(Arrays.asList(1, 2, 3, 4, 5));

        Collections.shuffle(list);

        System.out.println(list); // Output: (random permutation of the list)

        Collections.shuffle(list, new Random(42)); // Using a specific seed for reproducibility

        System.out.println(list); // Output: (a specific random permutation)

    }}
```

sort(List list): Sorts the specified list into ascending order, according to the natural ordering of its elements.

sort(List list, Comparator c): Sorts the specified list according to the order induced by the specified comparator.

```
import java.util.*;

public class SortExample {

    public static void main(String[] args) {        List<Integer> list = new ArrayList<>(Arrays.asList(5, 2, 8, 1));

        Collections.sort(list);

        System.out.println(list); // Output: [1, 2, 5, 8]

        List<String> strings = new ArrayList<>(Arrays.asList("zebra", "apple", "Banana"));

        Collections.sort(strings, String.CASE_INSENSITIVE_ORDER);

        System.out.println(strings); // Output: [apple, Banana, zebra]

    }}
```

Searching and Finding

binarySearch(List<? extends Comparable<? super T>> list, T key): Searches the specified list for the specified object using the binary search algorithm. The list *must* be sorted prior to making this call.

binarySearch(List<? extends T> list, T key, Comparator<? super T> c): Searches the specified list for the specified object using the binary search algorithm. The list *must* be sorted according to the specified comparator prior to making this call.

```
import java.util.*;


public class BinarySearchExample {
    public static void main(String[] args) {
        List<Integer> list = Arrays.asList(1, 3, 5, 7, 9); // Must be sorted!
        int index = Collections.binarySearch(list, 5);
        System.out.println(index); // Output: 2
        List<String> strings = Arrays.asList("apple", "banana", "zebra"); // Must be sorted!
        int stringIndex = Collections.binarySearch(strings, "banana");
        System.out.println(stringIndex); // Output: 1
    }
}
```

- **min(Collection<? extends T> coll):** Returns the minimum element of the given collection, according to the *natural ordering* of its elements.
- **min(Collection<? extends T> coll, Comparator<? super T> comp):** Returns the minimum element of the given collection, according to the order induced by the specified comparator.
- **max(Collection<? extends T> coll):** Returns the maximum element of the given collection, according to the *natural ordering* of its elements.
- **max(Collection<? extends T> coll, Comparator<? super T> comp):** Returns the maximum element of the given collection, according to the order induced by the specified comparator.

```
import java.util.*;

public class MinMaxExample {

    public static void main(String[] args) {

    List<Integer> numbers = Arrays.asList(3, 1, 4, 1, 5, 9);

System.out.println(Collections.min(numbers)); // Output: 1

        System.out.println(Collections.max(numbers));

// Output: 9


        List<String> strings = Arrays.asList("zebra", "apple",
"Banana");

        System.out.println(Collections.min(strings,
String.CASE_INSENSITIVE_ORDER));

// Output: apple

  System.out.println(Collections.max(strings,
String.CASE_INSENSITIVE_ORDER));

 // Output: zebra

    }

}
```

Creating Special Collections

emptyList(), emptySet(), emptyMap(): Returns empty, immutable lists, sets, and maps, respectively.

```
import java.util.*;
public class EmptyCollectionsExample {
    public static void main(String[] args) {
        List<String> emptyList = Collections.emptyList();
        System.out.println(emptyList); // Output: []
        // emptyList.add("test");
        // Throws UnsupportedOperationException
        Set<Integer> emptySet = Collections.emptySet();
        System.out.println(emptySet); // Output: []
        Map<String, Double> emptyMap = Collections.emptyMap();
        System.out.println(emptyMap); // Output: {}
    // Trying to add elements will result in UnsupportedOperationException
            try {
            emptyList.add("test");
            } catch (UnsupportedOperationException e) {
            System.out.println("Caught exception: " + e.getMessage());}
            try {
            emptySet.add(1);
            } catch (UnsupportedOperationException e) {
            System.out.println("Caught exception: " + e.getMessage());}
            try {
            emptyMap.put("key", 1.0);
            } catch (UnsupportedOperationException e) {
            System.out.println("Caught exception: " + e.getMessage());}
    }}
```

Comparable and Comparator

Both are interfaces in Java used for sorting objects. They define ways to compare two objects and determine their relative order and they have different purposes and usage:

1. Comparable

Definition: The Comparable interface is implemented by a class whose objects need to be ordered "naturally." It defines a *natural ordering* for objects of that class. It has a single method:

int compareTo(T o);

- This method compares the current object (this) with the specified object o.
- It returns:
  - A negative integer if this is less than o.
  - Zero if this is equal to o.
  - A positive integer if this is greater than o.

Usage: When a class implements Comparable, its objects can be sorted directly using methods like Collections.sort() or Arrays.sort().

Example:

```
import java.util.ArrayList;
import java.util.Collections;
import java.util.List;
class Student implements Comparable<Student> {
    String name;
    int rollNumber;
    public Student(String name, int rollNumber) {
        this.name = name;
        this.rollNumber = rollNumber;
    }
```

```
@Override
    public int compareTo(Student other) {
        // Compare based on roll number (natural ordering)
        return this.rollNumber - other.rollNumber; // Ascending
order
        // return other.rollNumber - this.rollNumber; //
Descending order
    }


    @Override
    public String toString() {
        return "Name: " + name + ", Roll Number: " +
rollNumber;
    }
}
```

```
public class ComparableExample {
    public static void main(String[] args) {
        List<Student> students = new ArrayList<>();
        students.add(new Student("Alice", 10));
        students.add(new Student("Bob", 5));
        students.add(new Student("Charlie", 15));
        Collections.sort(students);
        // Sorts based on compareTo()
        for (Student student : students) {
            System.out.println(student);
        }
        // Output: // Name: Bob, Roll Number: 5// Name:
Alice, Roll Number: 10 // Name: Charlie, Roll Number:
15
    }}
```

2. Comparator

- Definition: The Comparator interface defines a comparison function that does *not* require the objects being compared to implement Comparable. It's used to define custom sorting logic or provide multiple ways to sort objects of the same class. It has a single method:

int compare(T o1, T o2);

  - This method compares the two specified objects o1 and o2.
  - It returns:
    - A negative integer if o1 is less than o2.
    - Zero if o1 is equal to o2.
    - A positive integer if o1 is greater than o2.
- Usage: Comparator is used with methods like Collections.sort(list, comparator) or Arrays.sort(array, comparator).

- Example:

```
import java.util.ArrayList;
import java.util.Collections;
import java.util.Comparator;
import java.util.List;
class Student { // Doesn't implement Comparable now
    String name;
    int rollNumber;
    public Student(String name, int rollNumber) {
        this.name = name;
        this.rollNumber = rollNumber;
    }
    @Override
    public String toString() {
        return "Name: " + name + ", Roll Number: " + rollNumber;
    }}
```

```
public class ComparatorExample {
    public static void main(String[] args) {
        List<Student> students = new ArrayList<>();
        students.add(new Student("Alice", 10));
        students.add(new Student("Bob", 5));
        students.add(new Student("Charlie", 15));
        // Comparator to sort by name
        Comparator<Student> nameComparator =
Comparator.comparing(s -> s.name);
        Collections.sort(students, nameComparator);
        System.out.println("Sorted by Name:");
        for (Student student : students) {
            System.out.println(student);
        }
```

```
 // Output:
        // Sorted by Name:// Name: Alice, Roll Number: 10
        // Name: Bob, Roll Number: 5// Name: Charlie, Roll
Number: 15
        // Comparator to sort by roll number in descending order
        Comparator<Student> rollNumberComparatorDescending =
Comparator.comparingInt(s -> s.rollNumber).reversed();
        Collections.sort(students,
rollNumberComparatorDescending);
        System.out.println("Sorted by Roll Number Descending:");
        for (Student student : students) {
            System.out.println(student);
        }
        // Output:// Sorted by Roll Number Descending:
        // Name: Charlie, Roll Number: 15// Name: Alice, Roll
Number: 10// Name: Bob, Roll Number: 5
    }}
```

Diff b/w Comparator and Comparable?

Feature	Comparable	Comparator
Interface	java.lang.Comparable	java.util.Comparator
Method	int compareTo(T o)	int compare(T o1, T o2)
Implemented by	The class whose objects are to be sorted	A separate class or lambda expression
Purpose	Defines natural ordering	Defines custom ordering or multiple orderings
Sorting Method	Collections.sort(list) or Arrays.sort(array)	Collections.sort(list, comparator) or Arrays.sort(array, comparator)

Serialization

It is the process of converting an object's state into a byte stream.

Deserialization

It is the reverse process: reconstructing an object from a byte stream.

This is useful for objects to storage (like files or databases) or transmitting them over a network.

example of serialization and deserialization:

```
import java.io.*;
class Person implements Serializable {
    private static final long serialVersionUID = 1L;
// Important for versioning
    String name;
    int age;
    transient String secret;
// This field will not be serialized
```

```
public Person(String name, int age, String secret) {
        this.name = name;
        this.age = age;
        this.secret = secret;
    }
@Override
    public String toString() {
        return "Name: " + name + ", Age: " + age + ", Secret: " +
secret;
    }
}
public class SerializationExample {
    public static void main(String[] args) {
        Person person = new Person("Alice", 30, "My super
secret!");
```

```
// Serialization
        try (FileOutputStream fileOut = new
FileOutputStream("person.ser");
             ObjectOutputStream out = new
ObjectOutputStream(fileOut)) {
            out.writeObject(person);
            System.out.println("Object serialized successfully.");
        } catch (IOException i) {
            i.printStackTrace();
        }
 // Deserialization
        Person deserializedPerson = null;
        try (FileInputStream fileIn = new
FileInputStream("person.ser");
             ObjectInputStream in = new
ObjectInputStream(fileIn)) {
deserializedPerson = (Person) in.readObject();
System.out.println("Object deserialized successfully.");
        } catch (IOException i) {
            i.printStackTrace();
        } catch (ClassNotFoundException c) {
            System.out.println("Person class not found");
            c.printStackTrace();
        }
        if (deserializedPerson != null) {
            System.out.println("Deserialized object: " +
deserializedPerson);
            // Output: Deserialized object: Name: Alice, Age: 30,
Secret: null (secret is transient)
        }}}
```

Explanation and Key Points:

1. Present in side java.io.Serializable interface.

2. This is a marker interface (it has no methods) that indicates that objects of this class can be serialized.

3. **serialVersionUID:** The private static final long serialVersionUID = 1L; field is crucial for versioning. It's a unique identifier for the class version. If you modify the class structure (e.g., add or remove fields), you should change the serialVersionUID to avoid InvalidClassException during deserialization of objects serialized with an older version of the class. If you don't explicitly declare serialVersionUID, the JVM calculates it based on the class structure, which can lead to issues if the class is modified.

4. **transient Keyword:** The transient keyword is used to mark fields that should *not* be serialized. In the example, the secret field is marked as transient, so it's not saved to the file, and its value is null after deserialization. This is useful for sensitive information that shouldn't be persisted.

5. **ObjectOutputStream:** The ObjectOutputStream is used to write objects to an output stream (in this case, a file stream). The writeObject() method serializes the object.

6. **ObjectInputStream:** The ObjectInputStream is used to read objects from an input stream. The readObject() method deserializes the object. It's important to cast the returned object to the correct type.

Java 8 Features:

1. Lambda Expressions

- **Definition:** Lambda expressions provide a concise way to represent anonymous functions (functions without a name). They enable functional programming in Java.
- **Example:**

```
import java.util.Arrays;

import java.util.List;


public class LambdaExample {

    public static void main(String[] args) {

        List<String> strings = Arrays.asList("apple",
"banana", "kiwi");

    // Using lambda expression to print each string

        strings.forEach(s -> System.out.println(s));


        // Lambda expression with multiple statements

        strings.forEach(s -> {

            String upperCase = s.toUpperCase();

            System.out.println(upperCase);

        });


        // Lambda expression for comparing strings (used in
sorting)

        strings.sort((s1, s2) -> s1.compareToIgnoreCase(s2));

        System.out.println(strings);

    }

}
```

2. Functional Interfaces

- **Definition:** Functional interfaces are interfaces with only one abstract method. They can be used with lambda expressions. The @FunctionalInterface annotation can be used to explicitly mark an interface as functional.
- **Example:**

```
@FunctionalInterface
interface MyFunction<T, R> {
    R apply(T t);
}
public class FunctionalInterfaceExample {
    public static void main(String[] args) {
        MyFunction<String, Integer> stringLength = s ->
s.length();
        int length = stringLength.apply("Hello");
        System.out.println(length); // Output: 5
    }}
```

3. Method References

- **Definition:** Method references are a shorthand for lambda expressions that refer to existing methods.
- **Example:**

```
import java.util.Arrays;
import java.util.List;
public class MethodReferenceExample {
    public static void main(String[] args) {
        List<String> strings = Arrays.asList("apple",
"banana", "kiwi");
        // Method reference to System.out::println
        strings.forEach(System.out::println);
        // Method reference to String::toUpperCase
strings.stream().map(String::toUpperCase).forEach(System
.out::println);
    }}
```

4. Stream API

- **Definition:** The Stream API provides a way to process collections of data in a functional style, allowing for operations like filtering, mapping, and reducing.
- **Example:**

```
import java.util.Arrays;
import java.util.List;
import java.util.stream.Collectors;
public class StreamExample {
    public static void main(String[] args) {
        List<Integer> numbers = Arrays.asList(1, 2, 3, 4, 5,
6, 7, 8, 9, 10);
        List<Integer> evenNumbers = numbers.stream()
                .filter(n -> n % 2 == 0)
                .collect(Collectors.toList());
        int sumOfSquares = numbers.stream()
                .map(n -> n * n)
                .reduce(0, Integer::sum);

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

5. Default Methods in Interfaces

- **Definition:** Default methods allow you to add new methods to interfaces without breaking existing implementations.
- **Example:**

```
interface MyInterface {
    void myMethod();
    default void defaultMethod() {
        System.out.println("Default implementation");
    }
}
class MyClass implements MyInterface {
    @Override
    public void myMethod() {
        System.out.println("My implementation");
    }}
```

```
public class DefaultMethodExample {
    public static void main(String[] args) {
        MyClass obj = new MyClass();
        obj.myMethod();      // Output: My implementation
        obj.defaultMethod();  // Output: Default
implementation
    }
```

6. **Static Methods in Interfaces**

- **Definition:** Java 8 allows static methods in interfaces, similar to classes.
- **Example:**

```
interface MyInterface {
    static void staticMethod() {
        System.out.println("Static method in interface");
    }
}
public class StaticMethodInterfaceExample {
    public static void main(String[] args) {
        MyInterface.staticMethod(); // Output: Static
method in interface
    }
}
```

a

7. Date and Time API (java.time)

- **Definition:** A new Date and Time API was introduced to address the shortcomings of the old Date and Calendar classes.
- **Example:**

```
import java.time.LocalDate;
import java.time.LocalTime;
import java.time.LocalDateTime;
import java.time.format.DateTimeFormatter;

public class DateTimeExample {
    public static void main(String[] args) {
        LocalDate today = LocalDate.now();
        LocalTime now = LocalTime.now();
        LocalDateTime currentDateTime =
LocalDateTime.now();
        System.out.println("Today's Date: " + today);
        System.out.println("Current Time: " + now);
        System.out.println("Current Date and Time: " +
currentDateTime);

        DateTimeFormatter formatter =
DateTimeFormatter.ofPattern("yyyy-MM-dd HH:mm:ss");
        String formattedDateTime =
currentDateTime.format(formatter);
        System.out.println("Formatted Date and Time: " +
formattedDateTime);
    }
}
```

8. Optional

- **Definition:** The Optional class is a container object that may or may not contain a non-null value. It helps avoid NullPointerExceptions.
- **Example:**

```
import java.util.Optional;


public class OptionalExample {
    public static void main(String[] args) {
        String str = "Hello";
        Optional<String> optionalStr = 
Optional.ofNullable(str);


        if (optionalStr.isPresent()) {
            System.out.println(optionalStr.get());
        }
 optionalStr.ifPresent(s -> 
System.out.println(s.toUpperCase()));


        String orElseValue = optionalStr.orElse("Default 
Value");
        System.out.println(orElseValue);


        Optional<String> emptyOptional = 
Optional.ofNullable(null);
        String orElseEmpty = emptyOptional.orElse("Default 
Value for Empty");
        System.out.println(orElseEmpty);
    }
}
```

Course : Java

Part : Advance JAVA

Advanced Java

Java is used to develop applications.

To develop an application using Java, you can use the following approaches:

1. **Standalone Application:**
   - A standalone application is a self-contained program that runs on a single computer.
   - Examples include console applications, GUI applications, and desktop applications.
2. **Web Application:**
   - A web application is an application that runs on a web server and is accessed through a web browser.
   - It interacts directly with the user.
3. **Enterprise Application:**
   - An enterprise application is a large-scale application that typically runs on a server with multiple clint.
   - It often uses a distributed architecture.

Components of a Web Application

A web application typically consists of two main components:

1. **Front-end:**
   - It is User interface which is visible to the user.
   - It is primarily built using HTML, CSS, and JavaScript.
2. **Back-end:**
   - The back-end handles the server-side logic and data processing.
   - It typically involves databases, servers, and application logic written in languages like Java, Python, or Node.js.

Types of Web Applications

1. **Static Web Applications:**
   - These applications doesn't change dynamically.
   - They are primarily HTML and CSS-based.
     - **Client-side Web Applications:**
     - **Server-side Web Applications:**

Java Editions

There are four main editions of Java:

Java SE (Standard Edition): Used for developing standalone applications.

Java EE (Enterprise Edition): Used for developing web and enterprise applications.

Java ME (Micro Edition): Used for developing applications for embedded devices.

JavaFX: Used for developing rich desktop applications.

Perspectives

Perspectives are used to specify the development environment to the specific type of application you're building.

There are two main perspectives in Java development environments:

Java Perspective: Primarily used for Java SE development.

Java EE Perspective: Primarily used for Java EE development.

There are two main types of classes in advanced Java:

1. **Normal Class:** A regular Java class that can be executed from the main method.
2. **Servlet Class:** A specialized class that extends the HttpServlet class and is used to handle HTTP requests and generate dynamic web content

steps to create servlet class

create a normal class in the project.

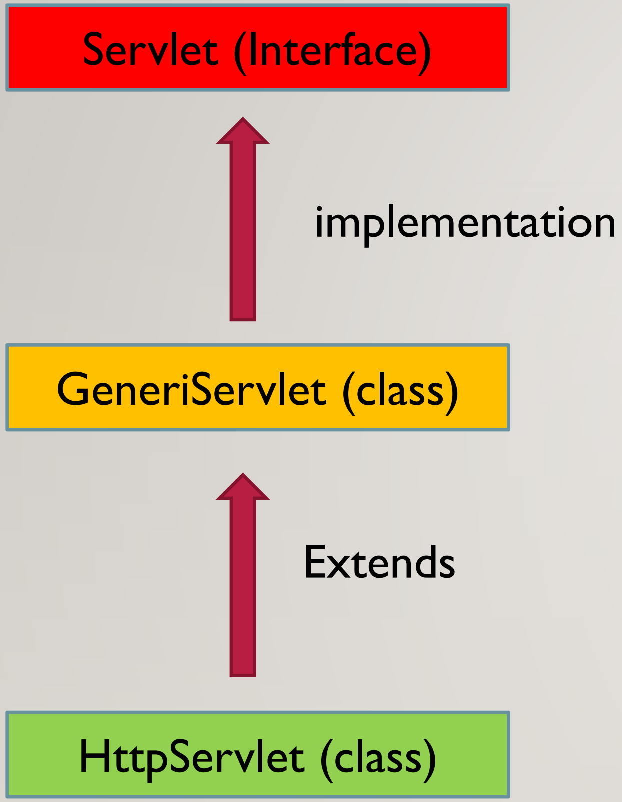
make a class to behave as implementation class (or) subclass for predefined servlet classes and interface.

All predefined classes are present in javax.servlet package

javax.servlet package is present in a jar file called servlet-api.jar

servlet-api.jar file is present inside Tomcat server

Servlet Hierarchy :



To create a servlet class by implementing the Servlet interface, you need to override all of its methods:

The Servlet interface defines five methods that must be implemented by any class that implements it:

1. **service():** This method is called by the servlet container to handle incoming requests. It's typically overridden to process requests and generate responses.
2. **destroy():** This method is called by the servlet container when the servlet is being unloaded. It's used to release resources and perform any necessary cleanup.
3. **getServletInfo():** This method returns information about the servlet, such as its author, version, and description.
4. **init():** This method is called by the servlet container when the servlet is first loaded. It's used to initialize the servlet and any resources it needs.
5. **getServletConfig():** This method returns a ServletConfig object, which provides information about the servlet's configuration.

Exa :

```
public class MyServlet implements Servlet {

public void service(ServletRequest req, ServletResponse res)
throws ServletException, IOException {}

    public void destroy() {

        // Clean up resources

    }

    public String getServletInfo() {

        return "My Servlet";

    }

    public void init(ServletConfig config) throws
ServletException {

        // Initialize the servlet

    }

    public ServletConfig getServletConfig() {

        // Return the servlet configuration

    }}
```

GenericServlet

To create a Servlet class by using the GenericServlet class, you need to override only one method:

The GenericServlet class is an abstract class that provides a basic implementation of the Servlet interface. It has one abstract method, service(), which you must override to handle requests.

Exa :

```
public class MyServlet extends GenericServlet {

public void service(ServletRequest req, ServletResponse res) throws ServletException, IOException {

        // Implement the logic to handle the request and generate the response

    }

}
```

HttpServlet :

If we want to create a Servlet class by using HttpServlet class we no need to complete any method.

HttpServlet class is an abstract class which is present with all complete methods

Exa :

```
public class Myservlet extends HttpServlet

{

 // no need to complete any method.

}
```

PrintWriter

- The PrintWriter class is a predefined class in the java.io package.
- It is used to write text to a character-output stream.
- To print output, we use two methods:

  1.print(): Prints the specified string without a newline.

  2.println(): Prints the specified string followed by a newline.
- Both print() and println() are non-static methods, so they must be called on an instance of the PrintWriter class.
- To create a PrintWriter object, we typically use the getWriter() method from a HttpServletResponse object.

Syntax:

PrintWriter out = resp.getWriter();

The getWriter() method takes no arguments and returns a PrintWriter object. This PrintWriter object can then be used to write text to the response.

Using PrintWriter:

```
out.print("Hello, world!");
out.println("This is a new line.");
```

Fetching Data from Front-end:

In the front-end (HTML), we use input tags to capture user input. Each input tag should have a unique name attribute to identify the data it represents.

Example:

```
<form action="your_servlet" method="post">
<input type="text" name="username">
<input type="password" name="password">
<input type="submit" value="Submit"></form>
```

Back-end

To fetch data from the front-end in the back-end, we use the getParameter() method.

The getParameter() method is a non-static method present in the ServletRequest interface. It takes a string argument representing the name of the parameter and returns the corresponding value as a string.

Syntax:

String value = req.getParameter("parameterName");

Exa: String email = req.getParameter("email");

String password = req.getParameter("password");

Annotations

- it use to do auto configuration which start from @ and follow pascal case.
- To replace XML-based configuration and reduce line of code, we can use the @WebServlet annotation. This annotation should be placed above the servlet class declaration.

@WebServlet Annotation

The @WebServlet annotation is used to specify the URL patterns that a servlet should handle. It takes a URL pattern as an argument.

Syntax:

@WebServlet("/url-pattern")

Handling Requests:

To handle HTTP GET, PUT and POST requests, we override the doGet(), doPut() and doPost() methods of the HttpServlet class. These methods receive HttpServletRequest and HttpServletResponse objects as parameters.

Syntax:

```
protected void doGet(HttpServletRequest req,
HttpServletResponse resp) throws ServletException,
IOException {

// Code to handle GET requests

}

protected void doPost(HttpServletRequest req,
HttpServletResponse resp) throws ServletException,
IOException {

   // Code to handle POST requests

}
```

- Servlet chaining is a technique in Java web applications where one servlet can forward a request to another servlet to handle processing.

There are two main ways to achieve servlet chaining:

1. **Using RequestDispatcher:**
    - The RequestDispatcher interface provides methods to forward requests to another resource, such as a servlet.

- To obtain a RequestDispatcher object, you can use the getRequestDispatcher() method of the ServletRequest object.

1. **Using sendRedirect():**

- The sendRedirect() method redirects the client to a different URL. This is useful for redirecting to external resources or to a different servlet.

RequestDispatcher Interface:
The RequestDispatcher interface is used to forward requests to another resource, such as a servlet or a JSP. It's located in the javax.servlet package.

Obtaining a RequestDispatcher Object:

To get a RequestDispatcher object, we use the getRequestDispatcher() method of the HttpServletRequest interface.

Syntax:

RequestDispatcher rd =
req.getRequestDispatcher("/path/to/resource");
The getRequestDispatcher() method takes a URL path as an argument and returns a RequestDispatcher object.

Servlet Chaining:

To combine the functionality of multiple servlets, we can use servlet chaining. This involves sending the request and response objects from one servlet to another.

Methods for Servlet Chaining:

Two common methods for servlet chaining are:

1. **forward():**
   - This method forwards the request to another resource, such as a servlet or a JSP.
   - The original request and response objects are passed to the target resource.
   - The client's browser URL remains unchanged.
2. **include():**
   - This method includes the content of another resource into the current response.
   - The original request and response objects are also passed to the included resource.
   - The client's browser URL remains unchanged.

sendRedirect() Method

The sendRedirect() method is used to redirect the client's browser to a different URL. This is useful for:

- Redirecting to a different page or servlet.
- Redirecting after a form submission.
- Redirecting after a successful operation.

Syntax:

response.sendRedirect("url");

- The url parameter can be a relative or absolute URL.
- It redirects the client's browser to the specified URL, and the original request and response objects are discarded.

Sending Additional Data with sendRedirect():

The sendRedirect() method itself doesn't directly allow you to send additional data to the target URL. However, you can use alternative methods to achieve this:

1. Hidden Input Fields:

- Create hidden input fields in your HTML form with the desired data.
- When the form is submitted, the values of these hidden fields will be included in the request parameters.
- In the target servlet, you can access these values using the getParameter() method.

2. URL Rewriting:

- Append the additional data as parameters to the URL in the sendRedirect() method.
- The target servlet can then extract the data from the request URL.

Example:

```
<form action="targetServlet" method="post">
<input type="hidden" name="hiddenData" value="secretValue">
<input type="submit" value="Submit">
</form>// In the target servletString hiddenValue =
request.getParameter("hiddenData");
```

Sending Data from Front-end to Back-end:

To send data from the front-end to the back-end using URL rewriting, you need to include the data as parameters in the URL. Use the & symbol to separate multiple parameters.

Example:

http://example.com/myServlet?name=Alice&age=30

In the back-end servlet, you can retrieve these values using the getParameter() method:

String name = request.getParameter("name");int age = Integer.parseInt(request.getParameter("age"));

Sending Data Between Servlets:

To send data from one servlet to another, you can use:

- **Session Objects:**
  - Create a session object using HttpSession session = request.getSession().
  - Store data in the session using session.setAttribute("key", value).
  - Retrieve data in the target servlet using session.getAttribute("key").
- **Cookie Objects:**
  - Create a cookie object using Cookie cookie = new Cookie("name", "value").
  - Set the cookie's attributes (e.g., expiration time, path, domain).
  - Add the cookie to the response using response.addCookie(cookie).
  - Retrieve the cookie in the target servlet using request.getCookies().

.

HttpSession Interface:

- **Definition:** HttpSession is an interface in the jakarta.servlet.http package. It represents a session between a client and a server.
- **Creating a Session:** To get a session object, we use the getSession() method of the HttpServletRequest interface. This method creates a new session if one doesn't exist or returns an existing session.

  HttpSession session = request.getSession();
- **Storing and Accessing Data:** We can store and retrieve data from the session using the setAttribute() and getAttribute() methods.

// Store datasession.setAttribute("key", value);// Retrieve dataObject value = session.getAttribute("key");

HttpSession Interface:

- The HttpSession interface represents a session between a client and a server. It's used to store session-specific data, such as user preferences, shopping cart items, or authentication information.

- The HttpSession interface is used to manage user sessions in web applications. It allows you to store and retrieve data associated with a specific user session.

Key Methods:

- **setAttribute(String key, Object value):**
  - Stores an object under the specified key in the session.
  - The value can be any object type.
- **getAttribute(String key):**
  - Retrieves the object associated with the specified key from the session.
  - The returned object needs to be cast to the appropriate type.

setAttribute() Method:

The setAttribute() method is used to store an object in the session. It takes two arguments:

1. **Key:** A string that identifies the object.
2. **Value:** The object to be stored.

Exa :

```
HttpSession session = request.getSession();
session.setAttribute("id", 101);
session.setAttribute("name", "Hiuga");
// Retrieve values
int id = (Integer) session.getAttribute("id");
String name = (String) session.getAttribute("name");
```

Setting Session Timeout

To set the maximum inactive interval for a session, we use the setMaxInactiveInterval() method. This method is available in the HttpSession interface.

Syntax:

```
session.setMaxInactiveInterval(seconds);
```

Course : Java
Part : JSP (Java Server Pages)

Code With Ved Prakash

JSP (JavaServer Pages)

- JSP stands for JavaServer Pages.
- It allows you to combine HTML code with Java code within a single file.
- This approach helps to overcome the limitations of using `PrintWriter` to generate dynamic HTML content.
- When a programmer needs to print only static HTML, they can use `PrintWriter`.
- However, when dynamic content and server-side logic are required, JSPs are a more convenient and efficient solution.
- The JSP engine automatically generates a servlet class for each JSP file at runtime.

JSP Tags

JSP (JavaServer Pages) files allow you to combine HTML and Java code within a single file. To structure and separate the different types of code, JSP provides three main types of tags:

1. **Declaration Tag:**
   - Used to declare variables and methods that can be accessed throughout the JSP page.
   - Syntax: <%! Java code %>
2. **Scriptlet Tag:**
   - Used to execute Java code within the JSP page.
   - Syntax: <% Java code %>
3. **Expression Tag:**
   - Used to print the value of an expression directly to the output.
   - Syntax: <%= expression %>

Syntax:

```
<%= expression %>
<%!
    int principle = 1000000;
    double interestRate = 10.5;
    int periodInYears = 10;
%>
<%
    double rateOfInterest = interestRate / 12 / 100;
    int periodInMonths = periodInYears * 12;
    double emi = principle * rateOfInterest * Math.pow(1 + rateOfInterest, periodInMonths) / (Math.pow(1 + rateOfInterest, periodInMonths) - 1);
%>

EMI: <%= emi %>
```

Course : Java
Part : JDBC Architecture:

Code With Ved Prakash

JDBC Architecture:

To understand database connectivity using JDBC, it's important to understand the key components of JDBC architecture:

1. **Java Application:**

   - It is used to collect user information.
   - Java application cannot store user information permanently so we make use of database application to store data permanently.

2. **JDBC Driver:**

   - A software component that enables communication between a Java application and a specific database.
   - It translates JDBC calls into database-specific calls.

3. **JDBC API:**

   - A set of interfaces and classes that define the standard way to interact with databases.
   - It provides methods for connecting to databases, executing SQL queries, and processing results.
   - It provide connection b/w database and java application.

2. **Database Driver:**

   - A software component provided by the database vendor that implements the JDBC API and interacts with the database.

Collecting User Information in Java Applications

We can collect user information in Java applications through two primary methods:

1. **Basic Level Data Collection:**
   - This involves using the Scanner class to read input from the console.
   - It's suitable for simple applications where user input is limited to text-based commands or data.
2. **High Level Data Collection:**
   - This involves using web technologies like HTML forms to collect user input.
   - The user interacts with the web page, fills out forms, and submits the data to the server.

Key Points:

- **Java Language:** Java applications can only understand Java code.
- **Database Language:** Databases understand SQL queries.
- **JDBC Driver's Role:** The JDBC driver converts Java-specific data and commands into SQL queries that the database can execute.

Reasons for using MySQL:

- **Cost-Effective:** MySQL is an open-source database, making it free to use.
- **Ease of Use:** It's relatively easy to learn and set up.
- **Popularity:** MySQL is a widely used database, making it a popular choice for developers.

Creating a Database in MySQL Workbench:

1. Open MySQL Workbench.
2. Connect to your MySQL server.
3. Right-click on the server connection and select "Create Schema."
4. Specify the desired name for your new database.
5. Click "Apply" and then "Finish."

CRUD operation query :

SELECT * FROM table_name; -- Selects all columns and rows

SELECT column1, column2 FROM table_name; -- Selects specific columns

INSERT INTO table_name (column1, column2) VALUES (value1, value2);

UPDATE table_name SET column1 = value1, column2 = value2 WHERE condition;

DELETE FROM table_name WHERE condition;

- **JDBC Connection steps**
  - For making connection b/w java and database we are using Connection interface
  - For Getting connection object we are using getConnection() method which is present in DriverManager class.
  - For taking input we have 2 interface PreparedStatement and statement.
  - If we want to take run time input then we are using PreparedStatement otherwise Statement interface, for getting this object we need to call PreparedStatement() or statement() which is present in side connection interface and it is non-static method so call by orv name.
  - Now for executing query we have 2 method executeQuery() and executeUpdate().
  - Which is present in side PreparedStatement or Statement interface and non-static method.
  - For executeUpdate() return type is intiger type and for executeQuery() return type is ResultSet.

Establishing a Database Connection in Java

To establish a connection between a Java application and a database, we use the Connection interface from the java.sql package. Here's a breakdown of the steps involved:

1. **Load the JDBC Driver:**
   - Load the appropriate JDBC driver for your database (e.g., MySQL, Oracle, PostgreSQL). This is typically done using the Class.forName() method.
2. **Establish a Connection:**
   - Use the DriverManager.getConnection() method to create a connection to the database.
   - Provide the database URL, username, and password as arguments.

Exa :

```
try {
// Replace with your JDBC driver class name
    Class.forName("com.mysql.cj.jdbc.Driver");
    Connection connection = DriverManager.getConnection(
        "jdbc:mysql://localhost:3306/mydatabase",   "username",
"password");
    // Use the connection to execute SQL queries
} catch (ClassNotFoundException | SQLException e) {
    e.printStackTrace();
}
```

getConnection() Method:

- The getConnection() method is a static method within the DriverManager class.
- It takes a URL as an argument, which specifies the database connection details (e.g., database URL, username, password).
- It returns a Connection object, representing the established database connection. Connection

  connection = DriverManager.getConnection(url);

Example:

```
try {
    Connection connection = DriverManager.getConnection("jdbc:mysql://localhost:3306/mydatabase", "username", "password");
    // Use the connection to execute SQL queries
} catch (SQLException e) {
    e.printStackTrace();
}
```

URL (Uniform Resource Locator)

Example: https://www.google.com/search

Key Components of a URL:

- **Protocol:** The communication protocol used to access the resource (e.g., HTTP, HTTPS, FTP).
- **Domain Name:** The address of the server hosting the resource.
- **Path:** The specific location of the resource within the server.

User Information:

- Usernames and passwords are essential for security when accessing databases.
- They help protect sensitive data from unauthorized access.

Database Connection Strings:

MySQL:

jdbc:mysql://localhost:3306?user=root&password=12345

Oracle:

jdbc:oracle:thin:@localhost:1521:XE?user=scott&password = tiger

Java Applications:

Java applications can combine both Java code (for business logic) and HTML code (for user interface) to create dynamic web applications.

Creating a Platform for Query Execution

A platform, such as a Java application, serves as a bridge between the Java code and the database. It allows you to write Java code to execute SQL queries and process the results.

Key Points:

- **Java Code vs. SQL Code:**
  - Java code is understood by the Java compiler.
  - SQL code is interpreted by the database engine.
- **Platform's Role:**
  - The platform is responsible for:
    - Converting Java code into SQL queries.
    - Sending the SQL queries to the database.
    - Processing the results returned by the database.
    - Presenting the results to the user.

Registering a JDBC Driver:

To establish a database connection in Java, you need to register the appropriate JDBC driver. This is typically done using the Class.forName() method.

Steps:

Load the Driver Class:

- Use Class.forName() to load the driver class.
- Provide the fully qualified class name of the JDBC driver as an argument.

Class.forName("com.mysql.cj.jdbc.Driver"); // For MySQL

Establish the Connection:

- Use DriverManager.getConnection() to create a connection to the database.
- Provide the database URL, username, and password as arguments.

Connection connection = DriverManager.getConnection("jdbc:mysql://localhost:3306/mydatabase", "username", "password");

ClassNotFoundException:

- The Class.forName() method can throw a ClassNotFoundException if the specified driver class is not found in the classpath.
- This is a checked exception, meaning you must handle it using a try-catch block.

Exa :

```
try {
    Class.forName("com.mysql.cj.jdbc.Driver");
    // code
} catch (ClassNotFoundException e) {
    e.printStackTrace();
}
```

Types of Platforms:

There are two types of platforms for executing SQL queries.

1. **Statement Platform:**
    - Uses Statement interface to execute static SQL queries.
    - Less efficient for repeated queries with different parameters.
2. **PreparedStatement Platform:**
    - Uses PreparedStatement interface to execute parameterized SQL queries.
    - More efficient and specially for dynamic queries.

Statement Interface:

The Statement interface provides methods for executing SQL statements. Here are two common methods:

1. **executeUpdate(String query):**
    - Used to execute SQL statements that modify data, such as INSERT, UPDATE, and DELETE statements.
    - Returns the number of rows affected by the statement.

2. **executeQuery(String query):**

   - Used to execute SQL statements that retrieve data, such as SELECT statements.
   - Returns a ResultSet object containing the result set.

Processing Resultant Data

In a database system, data can exist in two primary states:

1. Actual Data:

- This is the data that is permanently stored in the database.
- It's accessed and modified through SQL queries.

2. Resultant Data:

- This is temporary data that is generated as a result of executing a SQL query.
- It's typically stored in memory and can be accessed and processed by the application.

Database Query Execution:

When a SQL query is sent to the database, it undergoes a three-step process:

1. **Compilation:** The database compiler checks the syntax and semantics of the query.
2. **Execution:** The database engine executes the query, accessing and manipulating the actual data.
3. **Output:** The results of the query are returned to the application in the form of a result set.

Resultant Data :

- Data that is temporarily stored in memory after being retrieved from the database.
- It's not permanently stored in the database.

select * from employees;

Steps :

- The query is sent to the database.
- db compiler checks the syntax and semantics of the query.
- The database engine executes the query, retrieves the data from the employees table.
- The retrieved data is stored in buffer memory as a result set.
- The result set is sent back to the application.

Result Set and Buffer Memory

When you execute a SELECT query using a Statement object, the result is stored in a ResultSet object. This ResultSet object acts as a cursor over the result set, allowing you to iterate through the rows of data.

Buffer Memory:

- The ResultSet object maintains an internal buffer to store the data fetched from the database.
- This buffer memory typically holds a subset of the entire result set to optimize performance.
- The buffer memory is associated with two pointers:
  - **BFR (Before First Record):** Points to the position before the first row.
  - **ALR (After Last Record):** Points to the position after the last row.

Navigating the Result Set:

To move the cursor within the result set, you can use various methods provided by the ResultSet interface:

- **first():** Moves the cursor to the first row.
- **last():** Moves the cursor to the last row.
- **relative(int rows):** Moves the cursor relative to the current position.
- **next():** Moves the cursor to the next row.
- **previous():** Moves the cursor to the previous row.
- **absolute(int row):** Moves the cursor to the specified row number.

Getter Methods in ResultSet:

Getter methods in the ResultSet interface are used to retrieve data from a specific column in the result set. They accept either the column name or the column index as an argument.

Common Getter Methods:

- **getInt(columnLabel):** Retrieves an integer value from the specified column.
- **getString(columnLabel):** Retrieves a string value from the specified column.
- **getDouble(columnLabel):** Retrieves a double value from the specified column

Exa :

```
ResultSet rs = stmt.executeQuery("SELECT * FROM employees");

while (rs.next()) {
    int id = rs.getInt("empid");
    String name = rs.getString("ename");
    double salary = rs.getDouble("salary");
    // ...
}
```

PreparedStatement

A PreparedStatement is an interface in the java.sql package that represents a precompiled SQL statement. It's used to execute SQL statements with parameters, providing several advantages:

- **Performance:** Prepared statements are precompiled, which can significantly improve performance, especially for frequently executed queries.
- **Security:** Using prepared statements helps prevent SQL injection attacks by separating SQL statements from user-provided data.
- **Code Readability:** Prepared statements make your code more readable and maintainable.

Using PreparedStatement:

1. **Create a PreparedStatement:**

```
PreparedStatement preparedStatement = connection.prepareStatement("INSERT INTO employee VALUES (?, ?, ?)");
```

Set Parameters:

```
preparedStatement.setInt(1, 101);
preparedStatement.setString(2, "Dinga");
preparedStatement.setInt(3, 1000);
```

Using a PreparedStatement:

- **Setting Parameters:**
  - Use setInt, setString, setDouble, etc., to set values for the placeholders in the SQL statement.
- **Executing the Statement:**
  - Use executeUpdate() for INSERT, UPDATE, and DELETE statements.
  - Use executeQuery() for SELECT statements.

Setter Methods in PreparedStatement

Setter methods in the PreparedStatement interface are used to set values for the placeholders in a prepared statement. These methods accept two arguments:

1. **Placeholder Position:** An integer indicating the position of the placeholder in the SQL statement, starting from 1.
2. **Value:** The value to be assigned to the placeholder.

Common Setter Methods:

- setInt(int placeHolder, int value): Sets an integer value.
- setString(int placeHolder, String value): Sets a string value.
- setDouble(int placeHolder, double value): Sets a double value

Exa :

```
PreparedStatement pstmt =
connection.prepareStatement("INSERT INTO employees (id,
name, salary) VALUES (?, ?, ?)");

pstmt.setInt(1, 101);

pstmt.setString(2, "Alice");

pstmt.setDouble(3, 50000);

pstmt.executeUpdate();
```

EXA:

```
import java.sql.Connection;
import java.sql.DriverManager;
import java.sql.ResultSet;
import java.sql.SQLException;
import java.sql.Statement;
public class EmployeeDetail {
    public static void main(String[] args) {
        String url =
"jdbc:mysql://localhost:3306?user=root&password=12345";
        String select = "select * from training_employee";
try (Connection connection =
DriverManager.getConnection(url);
             Statement statement = connection.createStatement();
             ResultSet resultSet = statement.executeQuery(select))
while (resultSet.next()) {
                int id = resultSet.getInt("emp_id");
```

```
ResultSet resultSet = statement.executeQuery(select)) {
            while (resultSet.next()) {
                int id = resultSet.getInt("emp_id");
         String name = resultSet.getString("emp_name");
         double salary = resultSet.getDouble("emp_salary");
                int deptno = resultSet.getInt("emp_deptno");
                System.out.println("Emp id: " + id);
                System.out.println("Emp name: " + name);
                System.out.println("Emp salary: " + salary);
                System.out.println("Emp deptno: " + deptno);
            }
        } catch (SQLException e) {
            System.err.println("Error fetching employee details: " +
e.getMessage());
            e.printStackTrace(); // For debugging
        }}}
```

Exa :

```
import java.sql.Connection;
import java.sql.DriverManager;
import java.sql.PreparedStatement;
import java.sql.SQLException;
import java.util.Scanner;

public class Registration {
  public static void main(String[] args) {
        Scanner scanner = new Scanner(System.in);
        System.out.print("Enter first name: ");
        String firstName = scanner.nextLine();
String insert = "insert into userinfo (firstname, lastname, email, password) values (?, ?, ?, ?)";
        String url = "jdbc:mysql://localhost:3306/test?user=root&password=12345";
```

```
try (Connection connection = DriverManager.getConnection(url);
statement.setString(1, firstName);
int rowsInserted = statement.executeUpdate();
            if (rowsInserted > 0) {
System.out.println("Registration successful.");
            } else {
                System.out.println("Registration failed.");
            }
        } catch (SQLException e) {
            System.err.println("Error during registration: " + e.getMessage());
            e.printStackTrace(); // For debugging
        }
    }
}
```

Exa : 8 Employee detail

```html
<!DOCTYPE html>
<html>
<head>
    <title>Employee Detail</title>
</head>
<body><form action="empAction">
    <input type="text" placeholder="Enter Id" name="id">
    <input type="text" placeholder="Enter Name" name="name">
    <input type="number" placeholder="Enter Salary" name="salary">
    <input type="text" placeholder="Enter Department No" name="deptno">
    <input type="submit" value="Submit">
</form>
</body></html>
```

```java
public class EmpAction extends HttpServlet {
    protected void doPost(HttpServletRequest request, HttpServletResponse response) throws ServletException, IOException {
        String id = request.getParameter("id");
        String name = request.getParameter("name");
        String salary = request.getParameter("salary");
        String deptno = request.getParameter("deptno");
        String insert = "insert into employee (emp_id, emp_name, emp_salary, emp_deptno) values (?, ?, ?, ?)";
        String url = "jdbc:mysql://localhost:3306/test?user=root&password=12345";
        try (Connection connection = DriverManager.getConnection(url);
             PreparedStatement statement = connection.prepareStatement(insert)) {
         statement.setString(1, id);
             statement.setString(2, name);
```

```java
 statement.setString(3, salary);
            statement.setString(4, deptno);
            int rowsInserted = statement.executeUpdate();
            if (rowsInserted > 0) {
                response.getWriter().println("Employee details inserted successfully.");
            } else {
                response.getWriter().println("Error inserting employee details.");
            }
        } catch (SQLException e) {
            response.getWriter().println("Error: " + e.getMessage());
            e.printStackTrace(); // For debugging
        }
    }
}
```

xml file (.web.xml)

```xml
<web-app>
    <servlet>
        <servlet-name>employeeDetail</servlet-name>
        <servlet-class>com.EmployeeDetail</servlet-class>
        </servlet>

    <servlet-mapping>
        <servlet-name>employeeDetail</servlet-name>
        <url-pattern>/employeeDetail</url-pattern>
    </servlet-mapping>
</web-app>
```

Exa : reducing xml config with

@WebServlet(“/StudentLogin”) annotation

```
package com.jsp.student.servlet;
import javax.servlet.http.HttpServlet;
import javax.servlet.http.HttpServletRequest;
import javax.servlet.http.HttpServletResponse;
import java.io.IOException;


@WebServlet(“/StudentLogin”)
public class StudentLogin extends HttpServlet {
    @Override
    protected void doPost(HttpServletRequest req,
HttpServletResponse resp) throws ServletException,
IOException {
        String email = req.getParameter("email");
        String pass = req.getParameter("pass");
StudentDAO dao = new StudentDAOImplementation();
  StudentLogin studentLogin = dao.studentLogin(email, pass);
        // Assign the value from backend to object
    }
}
```

Course : Java

Part : Spring Framework

Spring Framework

- Open-source, loosely coupled, lightweight Java framework.
- Reduces complexity of developing enterprise applications.
- Supports various other frameworks like Hibernate.

Modules

- Core Container: Manages objects (beans) in an application.
- Data Access/Integration: Simplifies database interactions.
- Web: Simplifies web application development (MVC, security).
- AOP (Aspect-Oriented Programming): Implements cross-cutting concerns.
- Messaging: Supports asynchronous communication.
- Test: Offers tools for unit and integration testing.

Benefits

- Reduced complexity
- Loose coupling (components independent of each other)
- Improved maintainability
- Increased productivity

Configuration

- XML-based configuration: Defines beans and dependencies in XML files.
- Java-based configuration: Uses annotations for configuration within Java classes.

Core Container

- Manages object (bean) creation, configuration, and lifecycle.

Bean Scopes

- **Singleton:** Single instance for entire application lifecycle (default).
- **Prototype:** New instance for every bean request.

Dependency Injection

- Spring injects dependencies into beans:
  - **Constructor Injection:** Dependencies passed through the constructor.
  - **Setter Injection:** Dependencies injected using setter methods.

Annotations

- Common annotations for configuration and dependency injection:
  - @Component: Marks a class as a Spring bean.
  - @Autowired: Marks a field or method for dependency injection.
  - @Qualifier: Used with @Autowired to specify a particular bean.
  - @Bean: Used in Java-based configuration to define a bean method.

Spring JDBC

- Offers an abstraction layer for db Simplifies JDBC operation.

Principles

- **Inversion of Control (IoC):** Spring manages object creation and lifecycle.
- **Dependency Injection (DI):** Objects rely on Spring for dependencies.

IoC Container

- Manages object creation (beans).
- Focuses on business logic, not object creation.
- Uses ApplicationContext or BeanFactory for creation.
  - ApplicationContext supports XML and annotations.
  - BeanFactory supports only XML.

Bean

- Special object created by the IoC container.

Spring Configuration XML File

- Used for Java configurations.
- Uses tags to define beans.
- bean tag with id and class attributes defines a bean.

ApplicationContext

- Interface in org.springframework.context package.
- Supports both XML and annotation configuration.
- Implementation class: ClassPathXmlApplicationContext (in org.springframework.context.support).

Accessing Objects from IoC Container

- Use getBean( ) method in ApplicationContext.
- Provide bean id as an argument.
- Downcast the returned object to the required class.

Creating a Spring Core Java Project

1. Create a Java project.
2. Access Spring Core jar files.
3. Configure Java build path.
4. Create an XML file or import an existing one.
5. Create a class with the main method.
6. Access the IoC container and objects in the main method.

getBean( ) Method Overloads

1. Provide a class reference variable (downcast required).
2. Provide a reference variable and class name.
3. Provide only class name (throws exception if multiple objects exist).

Bean Scope

- Controls bean behavior using the scope attribute in the bean tag.
- Values:
  - singleton: Single instance.
  - prototype: New instance for each request.

Example:

<bean id="ref" class="fully.qualified.class.name"></bean>Demo demo = (Demo) context.getBean("demo");demo.sample();

Syntax:

1.Demo demo = (Demo) context.getBean("demo");
2.Demo demo = context.getBean("demo", Demo.class);
3.Demo demo = context.getBean(Demo.class); (throws exception if multiple)

Spring Configuration XML File

- Used for Java configurations.
- Uses tags to define beans.
- bean tag with id and class attributes defines a bean.

ApplicationContext

- Interface in org.springframework.context package.
- Supports both XML and annotation configuration.
- Implementation class: ClassPathXmlApplicationContext (in org.springframework.context.support).

Accessing Objects from IoC Container

- Use getBean( ) method in ApplicationContext.
- Provide bean id as an argument.

Downcast the returned object to the required class

getBean( ) Method Overloads

1. Provide a class reference variable (downcast required).
2. Provide a reference variable and class name.
3. Provide only class name.

Creating a Spring Core Java Project

1. Create a Java project.
2. Access Spring Core jar files.
3. Configure Java build path.
4. Create an XML file or import an existing one.
5. Create a class with the main method.
6. Access the IoC container and objects in the main method.

Accessing Objects from IoC Container

- Use getBean( ) method in ApplicationContext.
- Provide bean id as an argument.
- Downcast the returned object to the required class.

Constructor Injection (continued):

- **index attribute:** Used to specify the index position of a variable in the constructor arguments.

- **Index always starts with 0.**

c Namespace:

- XML property to avoid <constructor-arg> tag.
- Import URL: xmlns:c="http://www.springframework.org/schema/c"
- With c namespace, no need for name, index, type, value, or <value> tag.
- Mention variable names directly within the bean tag.

Example:

```
<bean id="emp4" class="org.jsp.employee.Employee"
c:name="King"    c:deptno="30"    c:salary="50000"
c:id="105"></bean>
```

Constructor Injection for Objects:

- Use ref attribute within <constructor-arg> tag.

Syntax:

```
<constructor-arg ref="referenceVariableName"></constructor-arg>
```

Passing Reference Variable:

- Use <ref> tag with bean attribute to pass the reference variable of the dependent.

Syntax:

```
<constructor-arg>  <ref bean= "referenceVariableName“> </ref>
</constructor-arg>
```

Passing List of Objects:

- Use <list> tag within <constructor-arg> tag.
- Inside <list>, use <ref> tag to pass object reference variables.

Syntax:

```
<constructor-arg>
<list>    <ref>refVariable1</ref>
<ref>refVariable2</ref>
<ref>refVariable3</ref></list>
</constructor-arg> a
```

Setter Injection

- Process of injecting data (dependencies) using setter methods.
- Involves:
  1. Default constructor to create an object.
  2. Setter methods to initialize non-static properties.
  3. IoC container uses setter methods after object creation.

Syntax:

1. Create setter methods for non-static properties.
2. Use <property> tag in the bean definition:
   a. name attribute: specifies the property name.
   b. value attribute: specifies the value to inject.

XML
<bean id="student3" class="com.jsp.setters.Student">
<property name="id" value="101"></property></bean>

p Namespace:

- XML property to avoid <property> tag.
- Import URL: xmlns:p=http://www.springframework.org/schema/p
- With p namespace, directly define properties within the bean tag.

Example:

<bean id="student3" class="com.jsp.setters.Student"
p:id="104" p:studentName="Raja"
p:studentemailid="raja@gmail.com"
p:studentPercentage="85.5"></bean>

Setter Injection for Objects:

- Use ref attribute within <property> tag to inject a reference to another bean.

Syntax:
<property name="address" ref="add"></property>

Passing Reference Variable:

•Use <ref> tag with bean attribute to pass the reference variable of the dependent.

Syntax:

<property>
<ref bean="referenceVariable"></ref>
</property>

Setter Injection vs. Constructor Injection?

Feature	Setter Injection	Constructor Injection
Method	Uses setter methods to inject	Uses constructor arguments to inject
XML Tag	<property>	<constructor-arg>
Identification	Setter method name (name attribute)	Constructor argument name/type/index
Speed	Slower (injection after creation)	Faster (injection during creation)
IoC Container Creation	Creates target bean first	Creates target bean first
Default Constructor	Uses 0-parameter constructor	Uses parameter constructors
XML Namespace	p namespace (optional)	c namespace (optional)

Autowire

- This annotation is use to inject automatic dependency injection.
- Replaces manual ref attribute usage.

Values:

- byName: Injects by property name (id must match variable name).
- byType: Injects by class name (setter injection).
- constructor: Injects through constructor arguments.

Note:

- @Autowired annotation is for non-primitive data types.
- Autowire values use camel case (e.g., byName).

Annotations

- Placed above class, method, or variable names.
- Executed at compile time or runtime.
- Optional in Java, but mandatory for Spring configuration.
- Reduce XML configuration and code size.

Important Spring Core Annotations:

- @Component: Creates a bean (object).
- @Autowired: Performs dependency injection (automatically).
- @Qualifier: Qualifies a bean for injection (if multiple candidates exist).
- @Bean: Defines a bean method in Java configuration.
- @ComponentScan: Scans for @Component annotations in packages.
- @Configuration: Marks a class as a Spring configuration class.
- @Value: Injects values from properties files or environment variables.

@Component:

- Replaces the <bean> tag for creating beans.
- Placed above the class definition.
- Requires <context:component-scan base-package="com.jsp.annotation.AutoWiredAnnotation"> in XML configuration to scan for @Component annotations.

Autowired:

- Performs automatic dependency injection for non-primitive data types.
- Used in three ways:
  - Above the non-primitive data type field.
  - Above the setter method.
  - Above a constructor with arguments.

@Qualifier:

- Used to specify which bean to inject when multiple beans of the same type are available.
- Avoids ambiguity in autowiring.

@Value:

- Injects values into fields or methods.
- Used for primitive data types.
- Can be used on fields, setter methods, or constructor arguments.

Java-Based Configuration

- ➢ Reduces XML configuration.
- ➢ @Configuration annotation on configuration classes.
- ➢ Defines beans using @Bean annotation on methods.
- ➢ Uses @ComponentScan to scan for @Component annotated classes.

Example:

```
@Configuration
@ComponentScan("com.example")
public class AppConfig {

    @Bean
    public MyService myService() {
        MyService service = new MyService();
        service.setRepository(myRepository());
        return service;
    }

    @Bean
    public MyRepository myRepository() {
        return new MyRepositoryImpl();
    }
}
```

Spring JDBC

- Simplifies database operations.
- Provides JdbcTemplate class for common database operations.
- Handles connection management and exception handling.

JdbcTemplate

- Pre-built methods for:
  - Insert, update, delete operations (update())
  - Select queries (queryForObject(), query())
- Requires a DataSource object to establish database connections.
- Uses RowMapper interface to map database results to Java objects.

Configuration

- XML-based or Java-based configuration.
- Define DataSource and JdbcTemplate beans.

Example (XML-based):

```
<bean id="dataSource"
class="org.springframework.jdbc.datasource.DriverManagerDataSourc
e">
<property name="driverClassName“
value="com.mysql.cj.jdbc.Driver"/>
<property name="url" value="jdbc:mysql://localhost:3306/mydb" />
<property name="username" value="root" /> <bean>
```

```
<bean id="jdbcTemplate"
class="org.springframework.jdbc.core.JdbcTemplate">
    <property name="dataSource" ref="dataSource" />
</bean>
```

Example (Java-based):

```
@Configuration
public class AppConfig {
    @Bean
    public DataSource dataSource() {
        DriverManagerDataSource dataSource = new
DriverManagerDataSource();
     dataSource.setDriverClassName("com.mysql.cj.jdbc.Driver");
        dataSource.setUrl("jdbc:mysql://localhost:3306/mydb");
        dataSource.setUsername("root");
        dataSource.setPassword("password");
        return dataSource;
    }
    @Bean
    public JdbcTemplate jdbcTemplate(DataSource dataSource) {
        return new JdbcTemplate(dataSource);
    }}
```

RowMapper

- Interface used to map database results to Java objects.
- mapRow() method is implemented to map each row.
- BeanPropertyRowMapper can be used for simplify mapping.

Database Operations

- **Insert, Update, Delete:**

```
jdbcTemplate.update(sql, new
PreparedStatementSetter() {
// Set parameters here
});
```

- **Select (single row):**

```
Object result = jdbcTemplate.queryForObject(sql, new
RowMapper<Object>() {
    // Map result to an object
});
```

- **Select (multiple rows):**

```
List<Object> results = jdbcTemplate.query(sql, new
RowMapper<Object>() {
 // Map each row to an object });
```

Course : Java

Part : Spring data

Spring Data JPA (Java persistence API)

- Simplifies data access with JPA.
- Provides JpaRepository interface for common CRUD operations.
- Uses annotations for mapping entities to database tables.

Additional Topics:

- Spring MVC (Model-View-Controller)
- Spring Security
- Spring Boot
- Spring AOP
- Spring Batch

Spring Integration

Note: This is a brief overview. For more in-depth information, refer to official Spring documentation and tutorials.

Sources and related content

XML-Based Configuration:

```
<bean id="temp"
class="org.springframework.jdbc.core.JdbcTemplate">
<property name="dataSource" ref="ds"></property></bean>
```

```
<bean id="ds"
class="org.springframework.jdbc.datasource.DriverManagerDataSource">
<property name="url“
value="jdbc:mysql://localhost:3306/demo"></property>
    <property name="username" value="root"></property>
    <property name="password" value="12345"></property>
    <property name="driverClassName"
value="com.mysql.jdbc.Driver"></property>
</bean>

<bean id="empdao"
class="com.jsp.jdbc.SpringJdbcByUsingXmlFile.Dao.EmployeeDaoImp">
    <property name="jdbcTemplate" ref="temp"></property>
</bean>

<bean id="emp"
class="com.jsp.jdbc.SpringJdbcByUsingXmlFile.model.Employee"></bean>
```

Java-Based Configuration:

```
@Configuration
@ComponentScan(basePackages = "org.jsp.jdbc")
public class EmployeeConfig {
  @Bean
  public JdbcTemplate getJdbcTemplate() {
    return new JdbcTemplate(getDataSource());  }
  @Bean
  public DataSource getDataSource()  {
    DriverManagerDataSource dataSource = new
    DriverManagerDataSource();
dataSource.setDriverClassName("com.mysql.cj.jdbc.Driver");
    dataSource.setUrl("jdbc:mysql://localhost:3306/demo");
    dataSource.setUsername("root");
    dataSource.setPassword("12345");
    return dataSource;    }}
```

Database Operations:

Write Operations (update())

- Use update() method from JdbcTemplate.
- Arguments:
  - String sql: Write query (INSERT, UPDATE, DELETE).
  - PreparedStatementSetter pss: Provides runtime values for placeholders.

Syntax:

```
jdbcTemplate.update(String sql, PreparedStatementSetter pss);
```

Example:

```
String sql = "INSERT INTO users (name, email) VALUES (?, ?)";jdbcTemplate.update(sql, (ps) -> {    ps.setString(1, "John Doe");    ps.setString(2, "john.doe@example.com");});
```

Read Operations

- Use queryForObject() for single data retrieval.
- Use query() for multiple data retrieval.
- Both methods are argument methods.
- Arguments:
  - String sql: Read query (SELECT).
  - RowMapper<T> rowMapper: Maps database records to Java objects.

Syntax:

```
// Single data
Object result = jdbcTemplate.queryForObject(String sql,
RowMapper<T> rowMapper);
// Multiple
dataList<T> results = jdbcTemplate.query(String sql,
RowMapper<T> rowMapper);
```

RowMapper Interface

- Used to map database data to Java objects.
- Contains mapRow() method (incomplete) for mapping each row.
- Arguments:
    - ResultSet: Retrieves data from the database.
    - int rowNum: Current row number.

Example (Simple Mapping):

```
class User {
  private String name;
  private String email;
  // Getters and setters
}
```

```
public class UserMapper implements RowMapper<User> {
  @Override
  public User mapRow(ResultSet rs, int rowNum) throws
SQLException
 {
    User user = new User();
    user.setName(rs.getString("name"));
    user.setEmail(rs.getString("email"));
    return user;

  }
}
```

RowMapper Implementation:

- Create a class implementing RowMapper<T>.
- Specify the class type for the mapped object.
- Override mapRow() method.
- Use ResultSet getters to retrieve data for each row.
- Set retrieved data to object properties.

Example:

```
class User {
  private String name;
  private String email;
  // Getters and setters
}
public class UserMapper implements RowMapper<User> {
  @Override
  public User mapRow(ResultSet rs, int rowNum) throws
SQLException
 {
   User user = new User();
   user.setName(rs.getString("name"));
   user.setEmail(rs.getString("email"));
   return user;
 }}
```

BeanPropertyRowMapper:

- Simplifies object mapping for classes with matching property names.
- Use BeanPropertyRowMapper<T>(EntityClass.class) construtor.

Syntax:

```
BeanPropertyRowMapper<User> mapper = new
BeanPropertyRowMapper<>(User.class);
```

JPA Project Setup (Eclipse):

1.Create New Project:

- Go to "File" -> "New" -> "Other..."
- Select "JPA Project" and click "Next."

2.Project Details:

- Enter project name, target runtime, and JPA version.
- Choose "Basic JPA configuration."
- Click "Next."

3.JPA Provider:

- Select "EclipseLink" and desired version.
- Choose "Disable Library Configuration."

4.Database Connection:

- Select the previously created MySQL connection.

JPA Project Structure:

- **Source:** Contains Java source files for your application.
- **Build:** Used for testing and building the project.
- **META-INF:** Contains persistence.xml for configuring JPA.

persistence.xml Configuration:

1. Open persistence.xml in the META-INF folder.
2. Set Transaction-Type to "RESOURCE_LOCAL."
3. Choose "populated from connection" for connection details.
4. Select the previously created MySQL connection.
5. Save the file.

Entity Class:

- Represents database tables.
- Mapped to database tables using Object-Relational Mapping (ORM).
- Follows conventions for table and column names:
  - Entity class name suggests table name.
  - Variable names suggest column names.
- Annotated with @Entity to mark it as a JPA entity.
- Primary key identified by @Id annotation.

Creating an Entity Class:

1.Create a JPA project.
2.Configure database connection in persistence.xml.
3.Create a package in the source folder.
4.Right-click on package -> New -> JPA Entity.
5.Enter class name and choose variables for table columns.
6.Select the primary key field.
7.Finish.

Generating Tables from Entity Class:

1. Right-click project -> JPA Tools.
2. Select "Generate Tables from Entities."
3. Finish.
4. Verify table creation in your database application.

Key Differences:

Connection Establishment:

- JDBC uses a static method DriverManager.getConnection(url).
- Hibernate uses Persistence.createEntityManagerFactory("ProjectName") to create an EntityManagerFactory.

- **Platform:**
    - ❑JDBC uses static platform types for executing queries.
    - ❑Hibernate uses the EntityManager interface for managing entity object states.

Diff b/w JDBC vs. Hibernate:

Feature	JDBC	Hibernate
Connection	DriverManager.getConnection(url)	Persistence.createEntityManagerFactory("ProjectName")
Return Type	Connection interface	EntityManagerFactory interface
Platform	Static methods (Statement, PreparedStatement, CallableStatement)	EntityManager

Hibernate EntityManager Operations (Formatted)

EntityManager:

- Manages entity lifecycles in JPA applications.
- Used to interact with the database.

Opening EntityManager:

EntityManagerFactory factory = Persistence.createEntityManagerFactory("ProjectName");EntityManager manager = factory.createEntityManager();

Starting Transaction:

manager.getTransaction().begin();

Database Operations:

- Perform operations like insert, update, delete, and retrieve.

Saving Changes:

- manager.getTransaction().commit();

Closing Resources:

manager.close();
factory.close();

Insert Operation (persist())

1. Create an entity object.
2. Initialize object variables using setters.
3. Call manager.persist(entityObject).

Syntax:

manager.persist(entityObject);

Retrieve Record (find())

- Use manager.find(EntityClass.class, primaryKeyValue).

Syntax:

EntityClass record = manager.find(EntityClass.class, primaryKeyValue);

Note:

- find() returns null if the primary key doesn't exist.

Update Operation

1. Use find() to retrieve the record.
2. Modify object state using setters.
3. No separate update method required. Changes are saved in commit().

Example:

```
Employee emp = manager.find(Employee.class, 103);
emp.setSalary(45000);
manager.getTransaction().commit();
```

Delete Operation (remove())

1. Use find() to retrieve the record (optional for safety).
2. Call manager.remove(entityObject).

Syntax:

```
manager.remove(entityObject);
```

Course : Java
Part : Spring data JPA

Spring Data JPA

Spring Data JPA is a high-level abstraction layer for JPA repositories. It simplifies data access by providing a repository interface-based approach.

Creating a Maven Project:

1. Create a Maven project with the spring-boot-starter-data-jpa dependency.
2. Add dependencies for database driver (e.g., MySQL Connector/J), Hibernate, and Spring Data JPA.

Configuring Persistence.xml:

- Configure the persistence unit name, JPA provider, and database connection details.

Entity Class:

- Annotate the class with @Entity.
- Define fields and getters/setters.
- Use @Id to mark the primary key field.

Repository Interface:

- Extend JpaRepository<T, ID> interface.
- Specify the entity type (T) and ID type (ID).
- Inherit CRUD methods: save(), deleteById(), findById(), findAll(), delete().

Example:

```
@Entity
public class User {
    @Id
    @GeneratedValue(strategy = GenerationType.IDENTITY)
    private Long id;
    private String name;
    private String email;
    // Getters and setters
}

public interface UserRepository extends JpaRepository<User, Long> {
// Custom query methods can be added here
}
```

Spring Configuration:

- Configure DataSource and EntityManagerFactory beans.
- Use @EnableJpaRepositories annotation to scan for repository interfaces.

diff b/w Spring Data JPA and Spring JPA?

Feature	Spring Data JPA	JPA
Definition	A framework built on top of JPA to simplify data access.	A specification for object-relational mapping in Java.
Purpose	To reduce boilerplate code and simplify data access operations.	To define the standard for how Java objects are mapped to relational databases.
Repository Implementation	Automatically generates implementations for repository interfaces.	Requires manual implementation of repository interfaces.
Querying	Supports method-based querying, JPQL, and native SQL.	Uses JPQL or native SQL for complex queries.
Integration with Spring	Seamlessly integrates with other Spring components.	Can be integrated with Spring but requires more configuration.
Complexity	Simpler to use, with a more developer-friendly API.	More complex to use, especially for complex queries.

Example:

```
@Configuration
@EnableJpaRepositories("com.example.repository")
public class AppConfig {
    @Bean
    public DataSource dataSource() {     // code       }
    @Bean
    //public LocalContainerEntityManagerFactoryBean
    entityManagerFactory() {        // code       }
    @Bean
     transactionManager() {
        JpaTransactionManager transactionManager = new
        JpaTransactionManager();
        transactionManager.setEntityManagerFactory(
        entityManagerFactory().getObject());
       return transactionManager;
    }}
```

Key Points:

- Spring Data JPA simplifies database operations by providing a repository-based approach.
- It automatically generates implementations for common CRUD operations.
- Custom query methods can be defined using JPQL or Spring Data JPA's query methods.
- Consider using @Query annotation or @NamedQuery for complex queries.
- Leverage Spring Data JPA's features like pagination, sorting, and specification for advanced data access scenarios.

JpaRepository

It is provides a set of predefined methods for common database operations.

Core Methods:

•save(Entity entity):

- Persists or updates an entity.
- Returns the saved entity.

•deleteById(ID id):

- Deletes an entity by its primary key.
- Throws EmptyResultDataAccessException if no entity is found.

•findById(ID id):

- Returns an Optional<Entity> containing the entity if found, otherwise an empty Optional.

•findAll():

- Returns a List of all entities.

•delete(Entity entity):

- Deletes an entity.

Custom Query Methods:

- Spring Data JPA allows creating custom query methods using method names.
- Use keywords like findBy, getBy, findDistinctBy, countBy, etc., followed by property names and keywords like And, Or, Not, Between, LessThan, GreaterThan, LessThanEqual, GreaterThanEqual, Like, StartingWith, EndingWith, Containing, OrderBy, Asc, and Desc.

Example:

```
public interface UserRepository extends JpaRepository<User, Long> {
List<User> findByFirstName(String firstName);
List<User> findByFirstNameAndLastName(String firstName, String lastName);
List<User> findByAgeGreaterThan(int age);}
```

Spring Data JPA Specifications:

- Create custom query specifications using Specification interface.
- Combine multiple criteria using CriteriaBuilder and Predicate.
- Dynamically construct complex queries.

Example:

```
public interface UserRepository extends JpaRepository<User,
Long>, JpaSpecificationExecutor<User> {    // ...}//
Usage:Specification<User> spec = (root, query,
criteriaBuilder) -> {
return criteriaBuilder.and(
criteriaBuilder.equal(root.get("firstName"), "John"),
criteriaBuilder.greaterThanOrEqualTo(root.get("age"), 30)
);};
List<User> users = userRepository.findAll(spec);
```

Creating Custom Methods:

- Use keywords like findBy, readOnlyBy, getBy, etc.
- Combine keywords with variable names from the entity class.
- Utilize operators like And, Or, Not, Between, etc.

Example:

```
public interface UserRepository extends JpaRepository<User,
Long> {
User findByEmailIdAndPassword(String email, String
password);
}
```

Course : Java

Part : Spring Web MVC

Spring Web MVC - Model-View-Controller Pattern

MVC Design Pattern:

- A development approach for building web applications.
- Separates the application into three layers:
  - **Model:** Holds application data (POJOs).
  - **View:** Renders the UI (JSP/HTML files).
  - **Controller:** Handles user requests and business logic.

Benefits:

- Improved code organization and maintainability.
- Easier testing and reusability of components.

Spring MVC Implementation:

- Spring MVC provides a framework for building MVC applications.
- Leverages key concepts like dependency injection and annotations.

Components:

- **Model:** POJO classes representing application data.
- **View:** JSP or HTML templates for displaying the UI.
- **Controller:** Handles user requests, interacts with the model, and returns views.

DispatcherServlet (Front Controller):

- Receives requests from the user.
- Maps requests to appropriate controllers.
- Manages the application flow.

Configuration:

- DispatcherServlet configured in web.xml file.
- Spring configuration file details view resolver and beans.

View Resolver:

- Responsible for resolving view names to actual JSP/HTML templates.
- Uses InternalResourceViewResolver by default.
- Configured with prefix and suffix for view paths.

Creating a Spring MVC Application:

1. Configure DispatcherServlet in web.xml.
2. Create a Spring configuration file with view resolver configuration.
3. Develop a controller class annotated with @Controller.
4. Create view templates (JSP/HTML files).

Benefits of Spring MVC:

- Simplified MVC implementation.
- Easier application development and testing.
- Leverage Spring features like dependency injection and annotations.

Setting Up a Spring MVC Project

1. Project Setup:

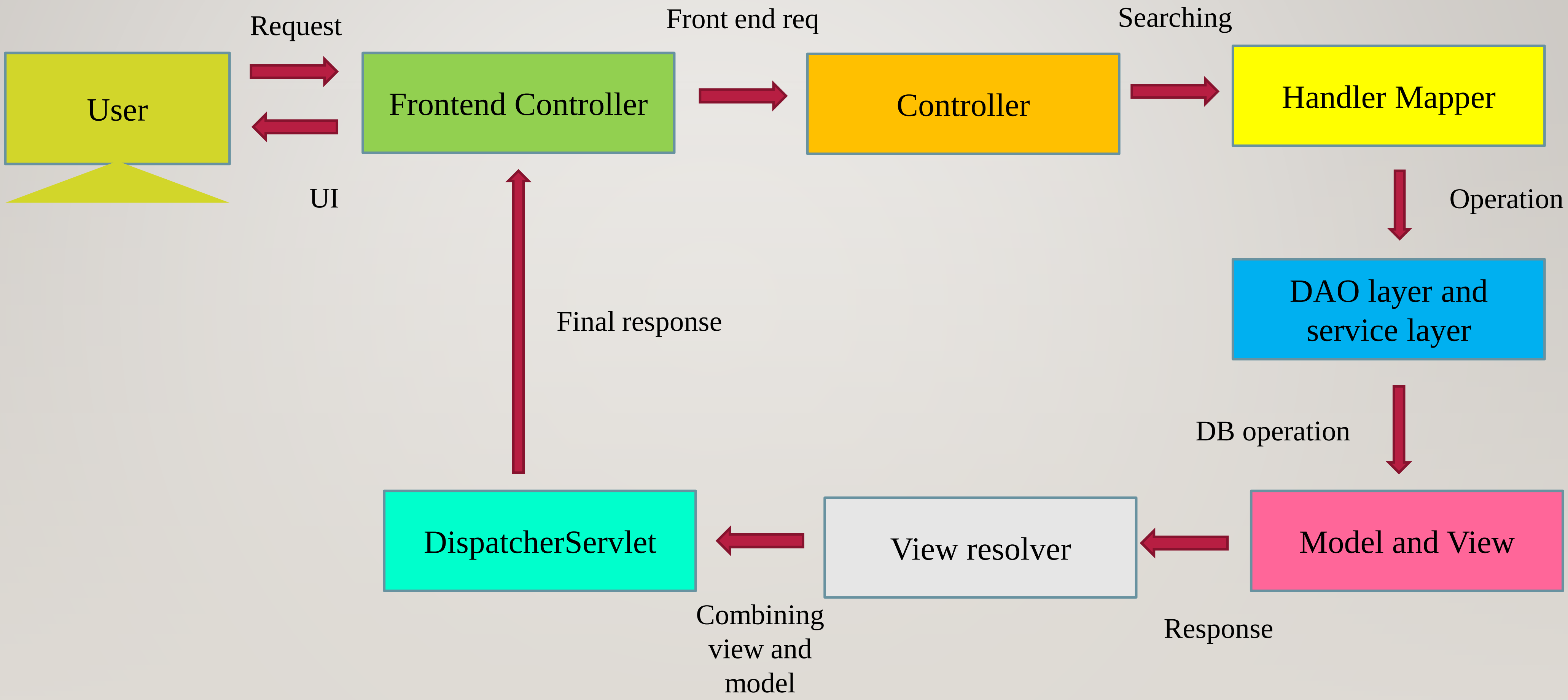
- **Create a Maven Project:** Use a Maven archetype to create a new web application project.
- **Set Java Version:**
  - Right-click on the project, go to "Properties" -> "Java Build Path".
  - Add Library -> JRE System Library -> Select Java 1.8.

Key Points:

- **DispatcherServlet:** The central controller of the Spring web application.
- **View Resolver:** Maps view names to physical views (JSPs, HTML, etc.).
- **@Controller:** Annotation to mark a class as a controller.
- **@RequestMapping:** Annotation to map HTTP requests to controller methods.
- **Model:** Used to pass data from the controller to the view.

By following these steps, you'll have a basic Spring MVC application set up. You can further customize it with more advanced features like form handling, validation, data binding, and more.

Diagram of Spring MVC Architecture :



Course : Java

Part : Spring Boot

Code With Ved Prakash

Spring Boot

A Simplified Approach to Spring Development

Spring Boot is a powerful tool that streamlines the development of Spring-based web applications. It offers two core features:

- **Auto-Configuration:** Spring Boot automatically configures your application based on the dependencies you include in your project. This eliminates the need for extensive manual configuration.
- **Opinionated Configuration:** Spring Boot provides default configurations for common scenarios, reducing the amount of boilerplate code you need to write.

Key Benefits of Spring Boot:

- **Simplified Setup:** Quickly set up a Spring-based application with minimal configuration.
- **Dependency Management:** Easily manage dependencies and their versions.
- **Embedded Server:** Run your application directly without deploying it to a separate server.
- **Auto-Configuration:** Leverage automatic configuration for common scenarios.
- **Production-Ready Features:** Benefit from features like metrics, health checks, and security.

Creating a Spring Boot Project:

Use Spring Initializr:

- Visit https://start.spring.io/
- Select your project dependencies (e.g., Spring Web, Spring Data JPA, Spring Security).
- Generate the project.

Use Your IDE:

- Create a new Spring Starter Project in your IDE (e.g., IntelliJ IDEA, Eclipse).
- Select your dependencies and project settings.

- @Getter @Setter @ToString @AllArgsConstructor @NoArgsConstructor @Data

  @Id @Repository, @Controller(o/p with frontend page), @Repository,
- @RestController(without frontend page);- @controller + @ResponseBody
- @Column
- (updatable = false):- first time only it will fill the data then it will not update.
- @Column(insertable = false):-Not necessary during insertion time.
- @CreatedDate :- automatically capture the created date.
- @CreatedBy :- Automatically populates the annotated field with the identifier of the user who created the entity.
- @MappedSuperclass :-act as a supper class in entity class

  @EntityListeners(AuditingEntityListener.class):- act as a supper class in entity class.
- @Entity :-is use to create table as a entity class.

- @Table(name=”xyz”):- it is also use to give name of the table in the db.
- @GeneratedValue(strategy = GenerationType.*IDENTITY*):- auto generated
- @Transactional :-using upside of method in case exception occurs it will rollback automatically.
- @Modifying :- when the query is not a select query, but instead performs an update, insert, or delete operation.
- @NotEmpty(message = "Branch Address cannot be a null ")
- @Schema(description = "Account type of Eazy Bank account", example = "Savings")
- @RequestMapping(path="/api", produces = {MediaType.*APPLICATION_JSON_VALUE*})
- @GetMapping @PostMapping @PutMapping @PatchMapping @DeleteMapping
- @RequestBody:-map the json/xml data to our entity object.
- @ResponseBody :- map the entity object to json/xml format.
- @RequerstParam, @QuetryParam:- used to extract parameters from HTTP requests

- @ResponseStatus(value = HttpStatus.*BAD_REQUEST/NOT_FOUND*) :- we are declearing this up side of exception class/veriable.
- @ControllerAdvice/@RestControllerAdvice :- for handling any global exception up of global exception class regarding controller class.
- @ExceptionHandler(Exception.class) :- class is going to handle the exception.
- @Transactional :-any error will be come at run time it will roll back
- @Modifying :- telling this method is going to modify
- void deleteByCustomerId(Long customerId); //repository methods
- For validating data eject dependency

<dependency>

<groupId>org.springframework.boot</groupId>

<artifactId>spring-boot-starter-validation</artifactId>

</dependency>

- And Extend your global exception to the not mandatory extends

ResponseEntityExceptionHandler

- @NotEmpty(message = "Name can not be a null or empty")
- @Size(min = 5, max = 30, message = "The length of the customer name should be between 5 and 30")
- @Email(message = "Email address should be a valid value")
- @Min(value = 0, message = "Price must be greater than or equal to 0")
- @Max(value = 10000, message = "Price must be less than or equal to 10000")
- @Future(message = "Event date must be in the future")
  - private Date eventDate;
- @Past(message = "Birthdate must be in the past")
- @AssertTrue(message = "User must accept terms");

private boolean acceptedTerms;

- @AssertFalse(message = "User must not be blocked")

private boolean blocked;

- @DecimalMin(value = "0.0", inclusive = false, message = "Price must be greater than 0") @DecimalMax(value = "10000.0", inclusive = true, message = "Price must be less than or equal to 10000") private BigDecimal price;
- @Pattern(regexp = "^[a-zA-Z0-9]+$", message = "Username must be alphanumeric")
- @SerializedName(value="customerId",alternate = {"customerID","customerid"})
- @Pattern(regexp = "(^$|[0-9]{10})", message = "Mobile number must be 10 digits")
- @PositiveOrZero(message = "Total loan amount paid should be equal or greater than zero")
- @PositiveOrZero(message = "Total loan amount paid should be equal or greater than zero")

- @Validated :- it is use to tell the class validate all the validation in controller class
- Spring. Open api's (Swagger UI)

```
<dependency>
    <groupId>org.springdoc</groupId>
<artifactId>springdoc-openapi-starter-webmvc-ui</artifactId>
    <version>2.3.0</version>
</dependency>
```

- @OpenAPIDefinition(

```
info = @Info(
  title = "Accounts microservice REST API
Documentation",
  description = "Olive Bank Accounts microservice REST
API Documentation",
  version = "v1",
  contact = @Contact(
    name = "Prakash",
    email = "prakash@eazybytes.com",
    url = "https://olivecrypto.com"
  ),
  license = @License(
    name = "Apache 2.0",
    url = " https://olivecrypto.com"
  )),
externalDocs = @ExternalDocumentation(
description =  "OliveBank Accounts microservice REST
API Documentation",
  url = " https://olivecrypto.com/swagger-ui.html"
))
```

It is regarding swagger header, written up side of main method

- @Tag(

```
    name = "CRUD REST APIs for Accounts in OliveBank",
description = "CRUD REST APIs in OliveBank to CREATE,
UPDATE, FETCH AND DELETE account details"
)
```

Head of the api's, written up side of class

- @Operation(

```
        summary = "Create Account REST API",
 description = "REST API to create new Customer &  Account
 inside OliveBank"
   )
  @ApiResponses({
      @ApiResponse(
          responseCode = "201",
          description = "HTTP Status CREATED"
      ),
  @ApiResponse(
          responseCode = "500",
          description = "HTTP Status Internal Server Error",
          content = @Content(
schema = @Schema(implementation = ErrorResponseDto.class)
          ))
  })    //It is use to give api description, written up side of method
```

- @Schema(
- name = "Customer",
- description = "Schema to hold Customer and Account
- information"
-)
- @Schema(description = "amount", maxLength = 9, minLength = 4, example = "3.00")
- It is use to give detail about the deoclass/class/variable . Up side of class or veriable
-
- @ComponentScans({ @ComponentScan("com.eazybytes.accounts.controller") })
- @EnableJpaRepositories("com.eazybytes.accounts.repository")
- @EntityScan("com.eazybytes.accounts.model")
- @EnableJpaAuditing(auditorAwareRef = "auditAwareImpl")
- If we are not declare main class as parent package then use this all annotation.
- @ConfigurationProperties(prefix = "accounts") :- use to make class as a configuration public record

(String message, Map<String, String> contactDetails, List<String> onCallSupport) {}

And declare this property on application.yml

```
accounts:
  message: "Welcome to EazyBank accounts related local APIs "
  contactDetails:
    name: "John Doe - Developer"
    email: "john@eazybank.com"
  onCallSupport:
    - (555) 555-1234
    - (555) 523-1345
```

//user diffin property

```
  @Autowired
  private AccountsContactInfoDto accountsContactInfoDto;
  @Inject
```

- 3Autowired :- same as auto wire but we want to migrate from java to python then use inject.

```
 @GetMapping("/contact-info")
    public ResponseEntity<AccountsContactInfoDto>
getContactInfo() {
        return ResponseEntity
                .status(HttpStatus.OK)
                .body(accountsContactInfoDto);
    }
```

It will allow only read not write. Only getter method is their.

@ConfigurationProperties(prefix = "accounts") :- main class use this for fetching all the configure property

Sort Cut For Eclipse

- control + shift + T / control + shift +R :
  finding classes or interface in side work space.
- control + H :
  finding particular word or sentence in side workspace.
- control + F :
  finding particular word in the file or classes .
- control + right-click :
  redirect to the pointer class or interface.
- control + K :
  redirect to particular variable declaration or same key word.
- control + shift + F :
  format code in organized manner.
- control + shift + W :
  close all file together.
- control + spacebar :
  suggestion for importing which you have return key word.
- control + shift + O :
  remove unused import statement at a time.
- control + / (or) control + shift + / (or) // (or) control + shift + C :
  comment or multiline comment
- control + shift + c (or) control + shift+ \ :
  uncomment or multiline uncomment.
- control + O :
  give out line for current class
- control + 1 :
  generate return type what evet called method is returning
- alt + shift + Z :
  generate design making statement or try catch block

- alt + left arrow / right arrow :
  going previous of forward place
- shift + alt + down arrow / up-arrow :
  generate duplicate copy of line for current line
- control + D :
  delete 1 line
- control + shift + X / Y :
  convert selected word to upper case or lower case.
- function +f4 / f6 :
  move next line / method during debug
- control + L :
  go to particular line

@

@

@

@

@

@

@