Core Java Concepts

Topics

- **Naming Convention in Java.**
- **Decision Making in Java.**
- **Java Variables.**
- **Java Return Type.**
- **Constructors in Java.**
- **Static keyword in java.**
- **Static Blocks.**
- **Static in Java.**
- **Static Class.**
- **This keyword in java**
- **Inheritance in Java**
- **Aggregation in Java**
- **Java Polymorphism**
- **Method Overloading**
- **Method Overriding in Java**
- **Interface in Java**
- **Abstract classes**
- **Access Modifier**
- **Java Enum**
- **Type conversion in Java with Examples**
- **Final Keyword In Java**

By Bhanu Pratap Singh
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https://www.udemy.com/seleniumbybhanu/

- **Runtime Polymorphism in Java**

- **Static Binding and Dynamic Binding**

- **Java instance of**

- **Encapsulation in Java**

- **What is Abstraction**

- **String In Java**

- **Java String Buffer class**

- **Java StringBuilder class**

- **Exception in Java**

- **throw exception in java**

- **throws Keyword**

- **Collections in Java**

- **Cloning in java**

- **Comparable in java**

- **Comparable in java**

- **Comparator in java**

- **Multithreading in java**

- **Others topic will be updated soon….**

Object, Class and Method

Class

A class is a user defined blueprint or prototype from which objects are created. It represents the set of properties or methods that are common to all objects of one type.
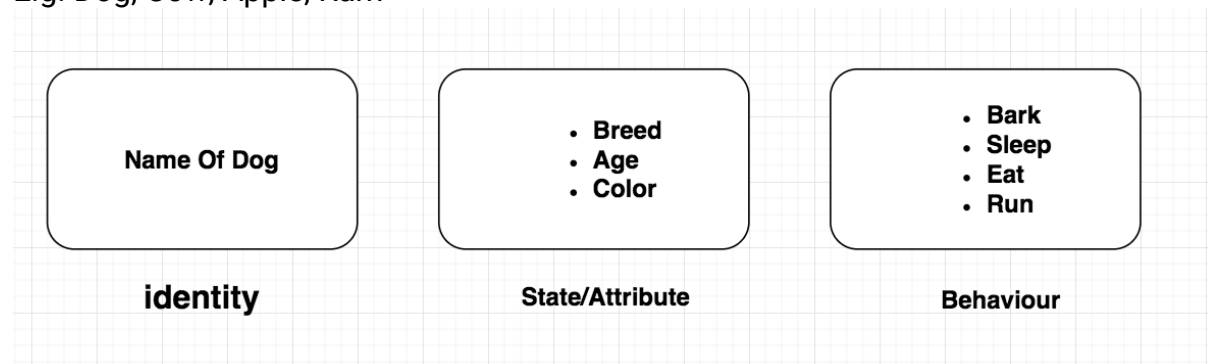
Class has

1. **Modifiers** : A class can be public or has default access.
2. **Class name:** The name should begin with a initial letter (capitalized by convention).
3. **Superclass(if any):** The name of the class's parent (superclass), if any, preceded by the keyword extends. A class can only extend (subclass) one parent.
4. **Interfaces(if any):** A comma-separated list of interfaces implemented by the class, if any, preceded by the keyword implements. A class can implement more than one interface.
5. **Body:** The class body surrounded by braces, { }.

Objects correspond to things found in the real world.
An object consists of :

1. **State** : It is represented by attributes of an object. It also reflects the properties of an object.
2. **Behaviour** : It is represented by methods of an object. It also reflects the response of an object with other objects.
3. **Identity** : It gives a unique name to an object and enables one object to interact with other objects.
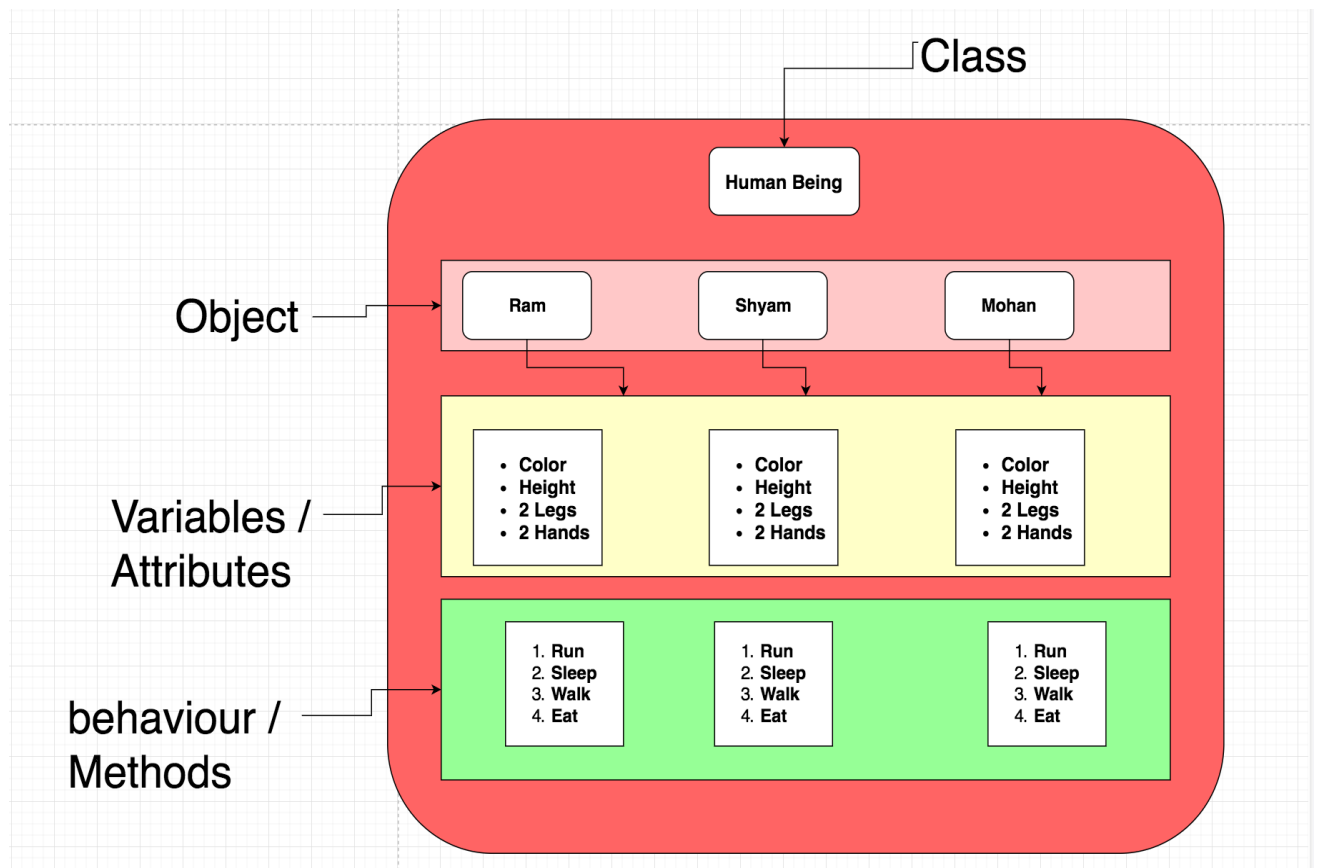
E.g. Dog, Cow, Apple, Ram

Name Of Dog	• Breed • Age • Color	• Bark • Sleep • Eat • Run
identity	State/Attribute	Behaviour

If we make 5 Object of same class, each object will have one copy of attributes/Behaviour

Class

Human Being

Object

Ram	Shyam	Mohan

Variables / Attributes

• Color • Height • 2 Legs • 2 Hands	• Color • Height • 2 Legs • 2 Hands	• Color • Height • 2 Legs • 2 Hands

behaviour / Methods

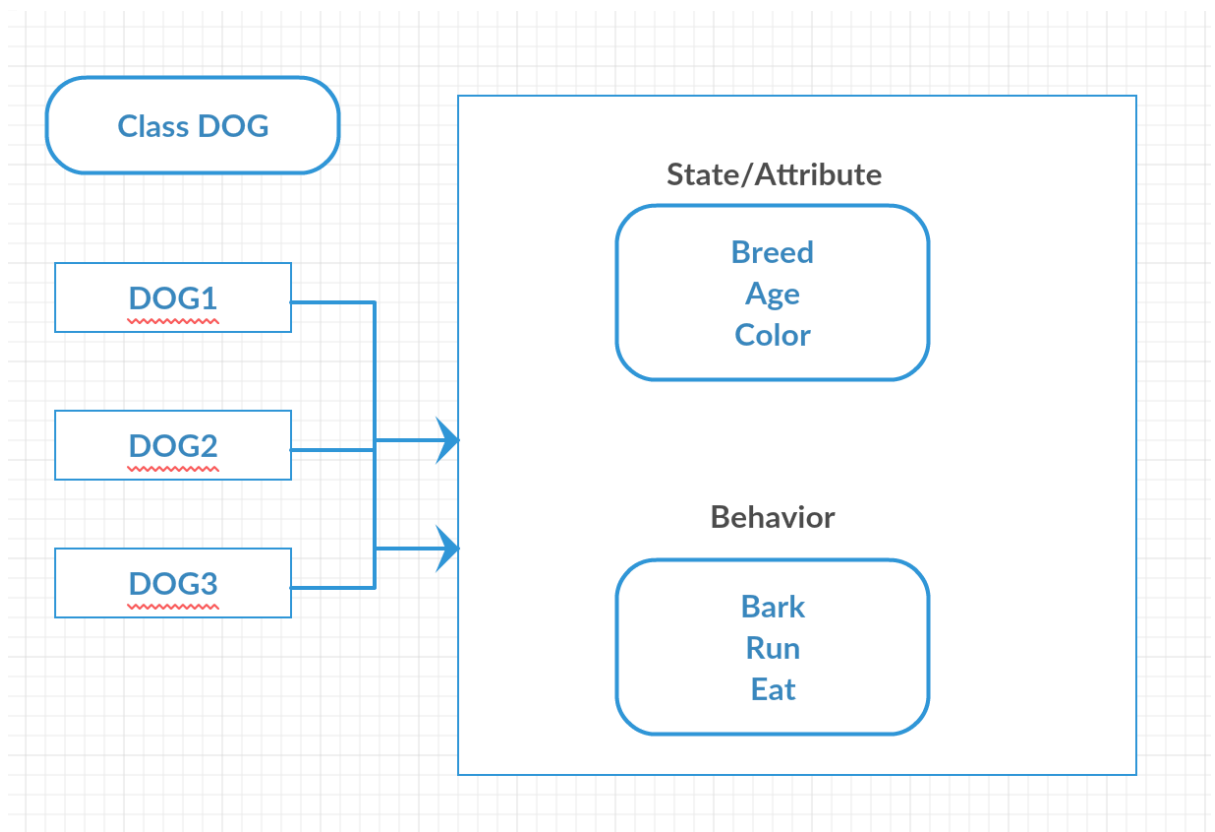| 1. Run 2. Sleep 3. Walk 4. Eat	1. Run 2. Sleep 3. Walk 4. Eat	1. Run 2. Sleep 3. Walk 4. Eat

Method in Java

In Java, a method is like a function which is used to expose the behaviour of an object.

Advantage of Method
- Code reusability
- Code optimisation.

```java
package ClassExample;

public class Example1 {
    int age;

    public int getAge() {
        return age;
    }
    public void setAge(int age) {
        this.age = age;
    }
    public static void main(String[] args) {
        Example1 obj1 = new Example1();
```

```
                obj1.setAge(4);
                obj1.getAge();

                Example1 obj2 = new Example1();
                obj1.setAge(6);
                obj2.getAge();
        }

}
```

public static void main(String[] args)

Java main method is the entry point of any java program. Its syntax is always public static void main(String[] args). You can only change the name of String array argument, for example you can change args to myStringArgs.

Also String array argument can be written as String... args or String args[].

public

This is the access modifier of the main method. It has to be public so that java runtime can execute this method. Remember that if you make any method non-public then it's not allowed to be executed by any program, there are some access restrictions applied. So it means that the main method has to be public.

static

When java runtime starts, there is no object of the class present. That's why the main method has to be static so that JVM can load the class into memory and call the main method. If the main method won't be static, JVM would not be able to call it because there is no object of the class is present

void

Java programming mandates that every method provide the return type. Java main method doesn't return anything, that's why it's return type is void. This has been done to keep things simple because once the main method is finished executing, java program terminates. So there is no point in returning anything, there is nothing that can be done for the returned object by JVM. If we try to return something from the main method, it will give compilation error as an unexpected return value.

package ClassExample;

```java
public class Example1 {


        public static void main(String[] args) {

                return 0;

        }

}
```

String[] args

Java main method accepts a single argument of type String array. This is also called as java command line arguments.

Naming Convention in Java.

- Class name Should always start with Uppercase.
- Method should start with lower class.
- Package name should always be lowercase.
- Constant should be in uppercase.

```java
package classExample;

public class Example1 {
        int age;
        static final int MAX_AGE = 18;

        public int getAge() {
                return age;
        }

        public void setAge(int age) {
                this.age = age;
        }

        public static void main(String[] args) {
                Example1 obj1 = new Example1();
```

```
        obj1.setAge(4);
        obj1.getAge();

        Example1 obj2 = new Example1();
        obj1.setAge(6);
        obj2.getAge();
    }
}
```
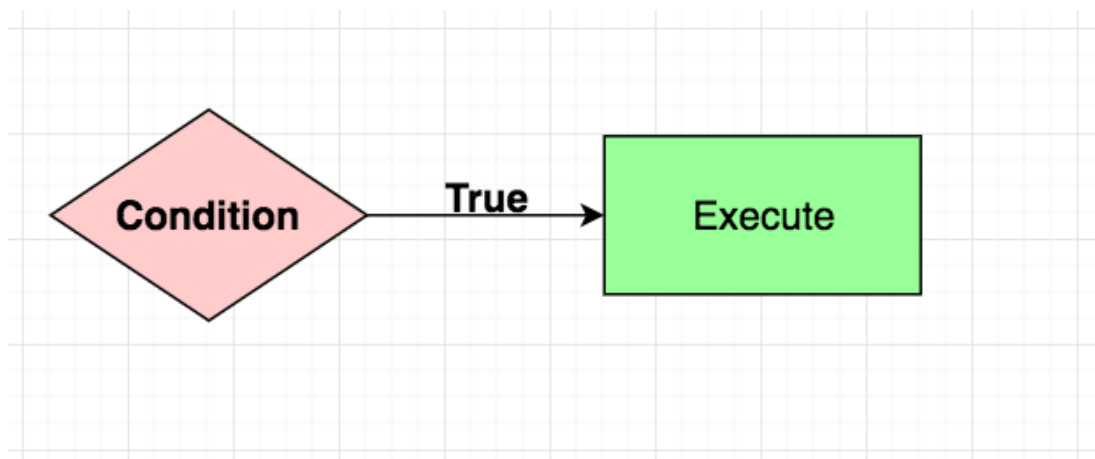
Decision Making in Java

- By Java If-else

- By JAVA Switch

- By JAVA For Loop

- BY JAVA While Loop

- JAVA Break

- JAVA Continue

if statement is the most simple decision making statement. It is used to decide whether a certain statement or block of statements will be executed or not i.e if a certain condition is true then a block of statement is executed otherwise not.
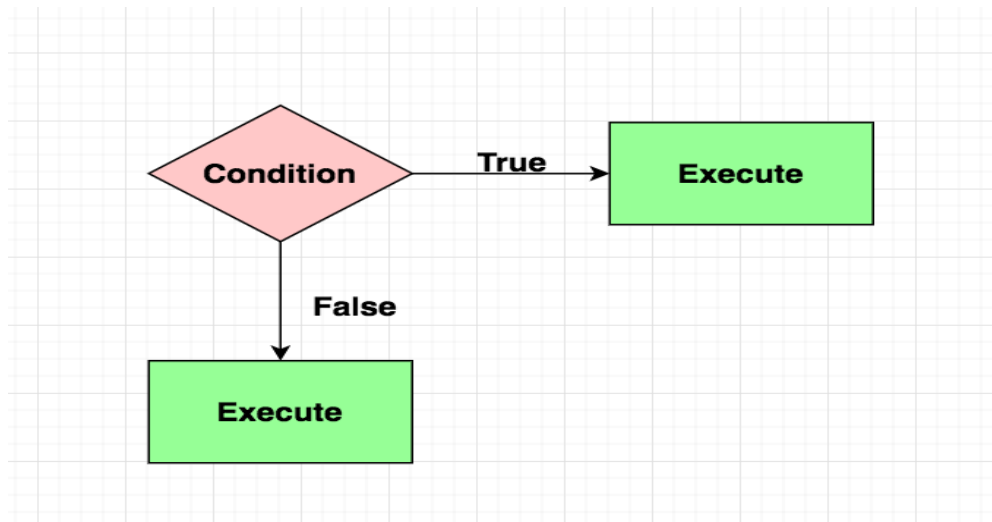
If

If else

```java
package controlStatements;

public class IfElseExample {

    static boolean condition;

    public static void main(String[] args) {
        if (condition) {
            System.out.println("IN IF PART");
        } else {
            System.out.println("In ELSE PART");
        }
    }
}
```

```java
package controlStatements;

public class IfElseExample1 {

    public void testAge(int age) {
        if (age > 18) {
            System.out.println("Person is Major");
        } else {
            System.out.println("Person is Minor");
        }
    }
}
package controlStatements;
```

```java
public class IfEleseifIF {

        public void testAge(int age) {
                if (age > 18) {
                        System.out.println("Person is Major");
                } else if(age < 5) {
                        System.out.println("Person is Minor");
                }

                else{
                        System.out.println("Invalid data");
                }
        }
}
```

switch-case

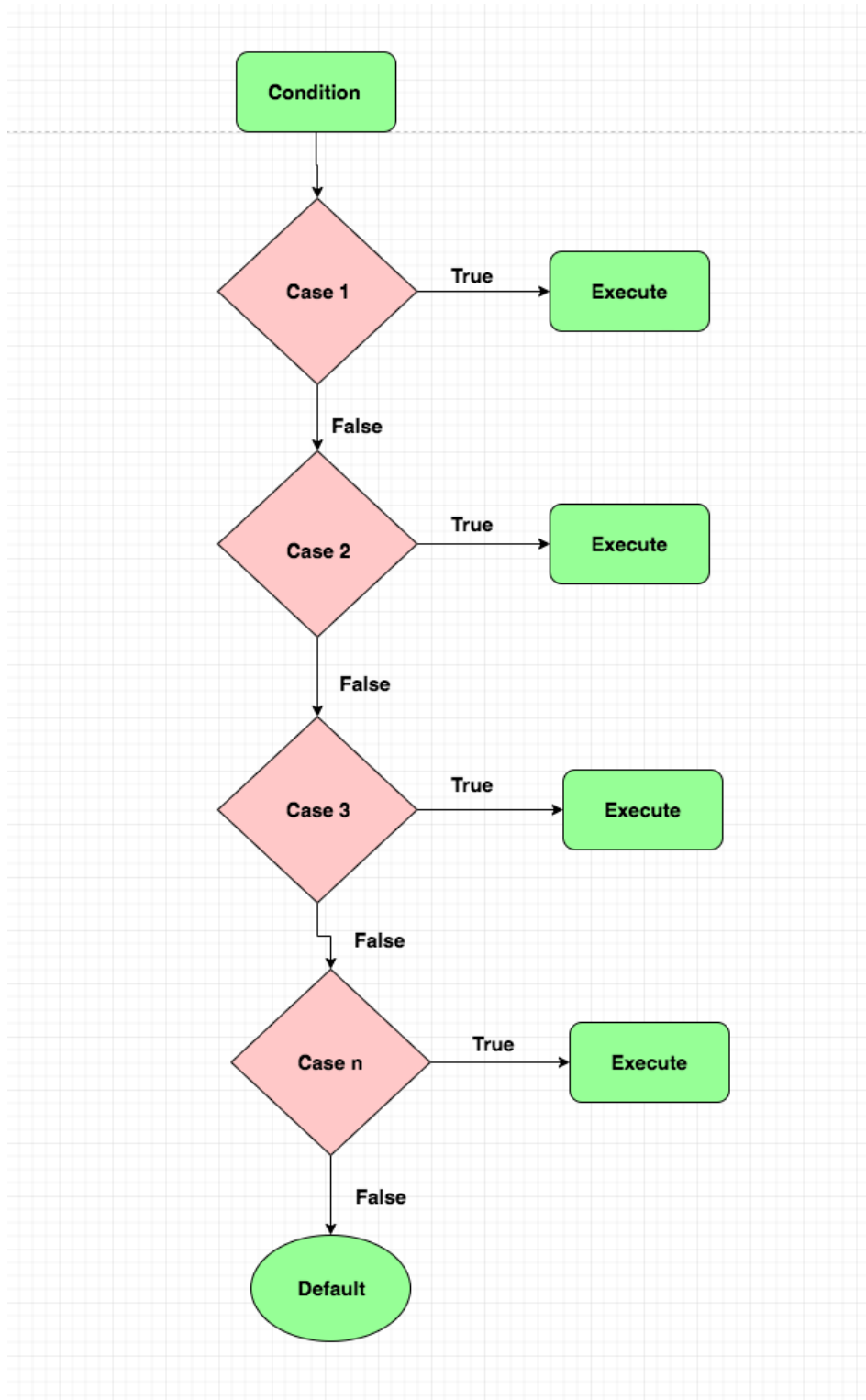switch-case The switch statement is a multiway branch statement. It provides an easy way to dispatch execution to different parts of code based on the value of the expression.

Syntax:

```
package controlStatements;
```

By Bhanu Pratap Singh
https://www.youtube.com/user/MrBhanupratap29/playlists
https://www.facebook.com/learnbybhanupratap/
https://www.udemy.com/seleniumbybhanu/

```java
public class SwitchExample {

    public void checkBookTypeAndPrice(String bookName) {
        String s1;
        switch (bookName) {
        case "MATH":
            s1 = "Author Aryabhata Price=200";
            System.out.println(s1);
            break;
        case "PHYSICS":
            s1 = "Author Bhanu Prata Price=100";
            System.out.println(s1);
            break;
        case "CHEMISTRY":
            s1 = "Author Pratap Price=300";
            System.out.println(s1);
            break;
        default:
            System.out.println("No Book Found Supply Proper Input");
        }
    }

    public static void main(String[] args) {
        SwitchExample switchExample = new SwitchExample();
        switchExample.checkBookTypeAndPrice("MATH");
    }

}



package controlStatements;

public class SwitchCaseExample1 {

    public static void main(String args[]) {
        int i = 9;
        switch (i) {
        case 0:
            System.out.println("i is zero.");
            break;
        case 1:
            System.out.println("i is one.");
```

```java
                    break;
            case 2:
                    System.out.println("i is two.");
                    break;
            default:
                    System.out.println("i is greater than 2.");
            }
        }
}
```

For Loop

The Java for loop is a control flow statement that iterates a part of the programs multiple times.

```java
package controlStatements;

public class ForLoopExample {

        public static void main(String[] args) {

                for (int i = 0; i < 8; i++) {
                        String string = "Running For Loop and count is=" + i;
                        System.out.println(string);
                }
        }
}
```

For Loop consists of four parts:

1. **Initialization**: It is the initial condition which is executed once when the loop starts. Here, we can initialize the variable, or we can use an already initialized variable. It is an optional condition.

2. **Condition**: It is the second condition which is executed each time to test the condition of the loop. It continues execution until the condition is false. It must return boolean value either true or false. It is an optional condition.

3. **Statement**: The statement of the loop is executed each time until the second condition is false.

4. **Increment/Decrement**: It increments or decrements the variable value. It is an optional condition.

```java
package controlStatements;
```

```java
public class ForLoopExample1 {

    public static void main(String[] args) {
        int array[] = { 120, 230, 404, 560, 708 };

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

For-each Loop

```java
package controlStatements;

public class ForEachLoopExample {

    public static void main(String[] args) {
        int array[] = { 120, 230, 404, 560, 708 };

        for (int i = 0; i < array.length; i++) {
            System.out.println(array[i]);
        }

        System.out.println("===========");

        for (int i : array) {
            System.out.println(i);
        }
    }
}
```

Labelled For Loop

```java
package controlStatements;

public class LabeledForLoop {

    public static void main(String[] args) {
        aa: for (int i = 1; i <= 5; i++) {
```

```java
bb: for (int j = 1; j <= 5; j++) {
        if (i == 2 && j == 2) {
                break aa;
        }
        System.out.println(i + " " + j);
    }
}
}
}
```

while loop

The Java *while loop* is used to iterate a part of the program several times. If the number of iteration is not fixed, it is recommended to use while loop.

```java
package controlStatements;

public class WhileLoopExample {

    public static void main(String[] args) {

        int i = 5;
        while (i <= 10) {
            System.out.println(i);
            i++;
        }
    }
}
```

```java
package controlStatements;

public class WhileExam {

    public static void main(String[] args) {
        int myNumber = 1;
        while (myNumber != 1000) {
            if ((myNumber % 2) == 0) {
                System.out.println(myNumber + " is even");
            }
            myNumber++;
        }
    }
}
```

```java
package controlStatements;

public class WhileLoopExample1 {

    public static void main(String[] args) {

        while(true){
            System.out.println("while loop is running in infinitive");
        }
    }
}
```

Indefinite While Loop

Flood example, let's look at a measure of danger. If we start with a danger rate of 2% per minute, how long will it take to reach 100%? Our while loop will run as long as the total danger rate is less than 100%:

```java
package controlStatements;

public class WhileLoopExample2 {

    public static void main(String[] args) {
        final double danger_rate = .02;
        int minute;
        minute = 0;
        double total_danger = 0;
        while (total_danger <= 1) {
            total_danger = danger_rate * minute;
            minute++;
        }

        System.out.println("danger hits 100% after " + minute + " minutes");
    }
}
```

Do While

```
package controlStatements;

public class DoWhileLoopExample {

    public static void main(String[] args) {
        int i = 0;
        do {
            i++;
        } while (i < 5);
    }

}
```

Java Break

```
package controlStatements;

public class BreakExample1 {

    public static void main(String[] args) {
        int i = 0;
        while (i >= 0) {
            if (i == 10) {
                break;
            }
            System.out.println("i counter="+i);
            i++;
        }
    }
}
```

```
package controlStatements;

public class BreakExample2 {

    public static void main(String[] args) {
        int array[] = { 120, 230, 404, 560, 708 };

        for (int i = 0; i < array.length; i++) {
            System.out.println(array[i]);
            if (array[i] == 560) {
```

```java
                        break;
                    }
                }
            }

    }


package controlStatements;

public class BreakExample2 {

    public static void main(String[] args) {
        int array[] = { 120, 230, 404, 560, 708 };

        for (int i = 0; i < array.length; i++) {
            for (int j = 0; j < array.length; j++) {
                System.out.println(array[j]);
                if (array[j] == 560) {
                    break;
                }
            }
        }
    }
}

package controlStatements;

public class BreakExample3 {

    public static void main(String[] args) {
        int array[] = { 120, 230, 404, 560, 708 };
        for (int i = 0; i < array.length; i++) {
            for (int j = 0; j < array.length; j++) {
                System.out.println(array[j]);
                if (array[j] == 560) {
                    break;
                }
            }
            break;
        }
    }
}
```

}

Java Continue Statement

The Java Continue statement is one of the most useful statement to controls the flow of loops. We generally use this statement inside the For Loop, While Loop and Do While Loop. While executing these loops, if compiler find the Java Continue statement inside them, it will stop the current loop iteration and starts the new iteration from the beginning.

```java
package controlStatements;

public class ContinueExample1 {

    public static void main(String[] args) {

        int array[] = { 120, 230, 404, 560, 708, 90, 10, 20 };

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

            if (array[i] < 560) {
                continue;
            }
            System.out.println("number is=" + array[i]);
        }
    }
}

package controlStatements;

public class ContinueExample2 {

    public static void main(String[] args) {
        for (int i = 0; i < 100; i++) {
            if (i > 10) {
                System.out.println("Skipped by continue value is=" + i);
                continue;
            }
            System.out.println("value of i is=" + i);
        }
    }
}
```

Java Variables

Java Variable is place holder which holds the data of variable in memory. There are three types of variables.

- Local
- Instance
- Static

```java
package VariableDataType;

public class Example1 {

        public int a = 90;

        public String s1 = "Test";

        public double d1 = 90.80;

        public float f1 = 90.80f;

        public long l1 = 90l;

        public static int b = 80;

        public static String s2 = "Test1";

        public void test(){
                int a = 80;
                System.out.println(a);
        }

        public void test1(int a){
                System.out.println(a);
        }
}
```

Data Type

Data types specify the different sizes and values that can be stored in the variable. There are two types of data types in Java:

1. Primitive data types: The primitive data types include boolean, char, byte, short, int, long, float and double.

2. Non-primitive data types: The non-primitive data types include Classes, Interfaces, and Arrays.

Data Type	Default Value	Default size
boolean	FALSE	1 bit
char	'\u0000'	2 byte
byte	0	1 byte
short	0	2 byte
int	0	4 byte
long	0L	8 byte
float	0.0f	4 byte
double	0.0d	8 byte

Data Type

```
                                              Long
                                              Int
                               Integer        Short
                                              Byte

                  Primitive    Floating Point    Float
                                                 Double

   Data Type                                  True
                               Boolean        False

                               Character

                                              String
                  Non-Primitive               Array
                                              Etc
```
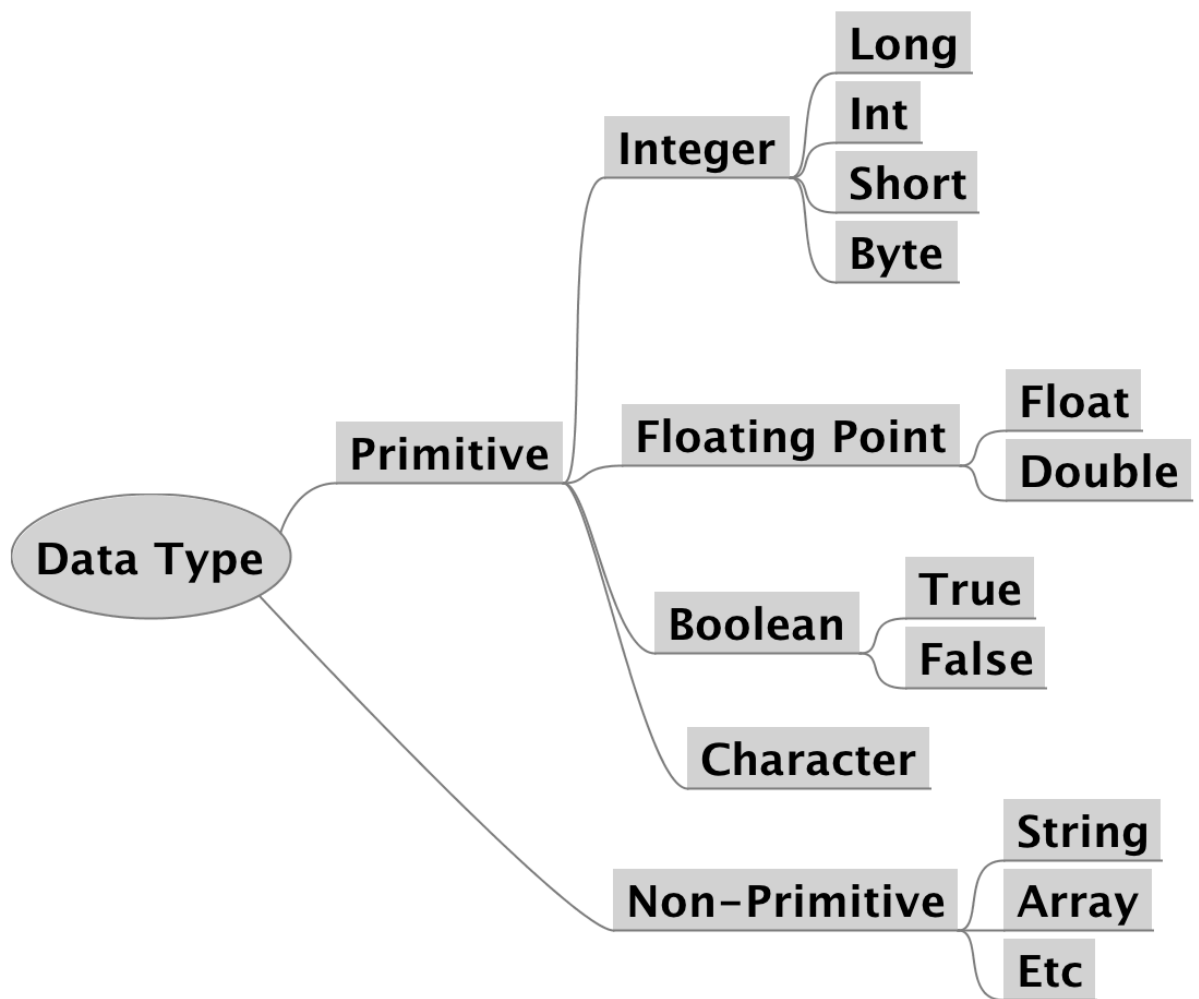
```java
public class DataType {

    public static void main(String[] args) {
        System.out.println(Byte.MIN_VALUE);
        System.out.println(Byte.MAX_VALUE);
        System.out.println(Short.MIN_VALUE);
        System.out.println(Short.MAX_VALUE);
        System.out.println(Integer.MIN_VALUE);
        System.out.println(Integer.MAX_VALUE);
        System.out.println(Long.MIN_VALUE);
        System.out.println(Long.MAX_VALUE);
```

```
            System.out.println(Double.MIN_VALUE);
            System.out.println(Double.MAX_EXPONENT);
            System.out.println(Double.MAX_VALUE);
    }
}
```

byte: The byte data type is an 8-bit signed two's complement integer. The byte data type is useful for saving memory in large arrays.
- Size: 8-bit
- Value: -128 to 127

short: The short data type is a 16-bit signed two's complement integer. Similar to byte, use a short to save memory in large arrays, in situations where the memory savings actually matters.
- **Size:** 16 bit
- **Value:** -32,768 to 32,767 (inclusive)

int
It is a 32-bit signed two's complement integer.
- **Size:** 32 bit
- **Value:** -2^{31} to $2^{31}-1$
- -2,147,483,648 to 2,147,483, 647

long: The long data type is a 64-bit two's complement integer.
- Size: 64 bit
- Value: -2^{63} to $2^{63}-1$.
-

Floating point Numbers : float and double

float: The float data type is a single-precision 32-bit **IEEE 754** floating point. Use a float (instead of double) if you need to save memory in large arrays of floating point numbers.
- **Size:** 32 bits
- **Suffix :** F/f Example: 9.8f

double: The double data type is a double-precision 64-bit IEEE 754 floating point. For decimal values, this data type is generally the default choice.

Note: Both float and double data types were designed especially for scientific calculations, where approximation errors are acceptable. If accuracy is the most prior concern then, it is recommended not to use these data types and use **BigDecimal** class instead.

Basically **single precision** floating point arithmetic deals with 32 bit floating point numbers whereas **double precision** deals with 64 bit. The number of bits in **double**

precision increases the maximum value that can be stored as well as increasing the **precision**

char
The char data type is a single 16-bit Unicode character. A char is a single character.
- Value: '\u0000' (or 0) to '\uffff' 65535

Java Return Type

Java requires that a method declare the data type of the value that it returns. If a method does not returna value, it must be declared to return void .


```java
package ReturnTypeInJava;

public class Example1 {

        private double d = 90.980;
        private String s1 = "Test";
        private int i = 90;
        private float f = 2.80f;
        private long l = 2l;
        private char c = 'a';
        private boolean b = true;

        private int[] array = {20,30,40};

        private Example1 example1;

        public double getD() {
                return d;
        }

        public String getS1() {
                return s1;
        }

        public int getI() {
                return i;
```

```java
        }

        public float getF() {
                return f;
        }

        public long getL() {
                return l;
        }

        public char getC() {
                return c;
        }

        public boolean isB() {
                return b;
        }

        public Example1 getExample1() {
                return example1;
        }


        public int[] getArray() {
                return array;
        }


}
```

Constructors in Java

Constructors are used to initialize the object's state. Like methods, a constructor also contains **collection of statements(i.e. instructions)** that are executed at time of Object creation.

constructors are used to assign values to the class variables at the time of object creation, either explicitly done by the programmer or by Java itself (default constructor).

When is a Constructor called ?
Each time an object is created using **new()** keyword at least one constructor (it could be default constructor) is invoked to assign initial values to the **data members** of the same class.

Rules for creating Java constructor

There are two rules defined for the constructor.

1. Constructor name must be the same as its class name

2. A Constructor must have no explicit return type

3. A Java constructor cannot be abstract, static, final, and synchronized

Types of Java constructors
There are two types of constructors in Java:
- Default constructor (no-arg constructor)
- Parameterized constructor

Default Constructor

```java
package constructor;

public class Example1 {
        public String name;
        public int i;

        Example1() {
        }

        public static void main(String[] args) {
                Example1 obj = new Example1();
                System.out.println(obj.name);
                System.out.println(obj.i);
        }
}
```

Parameterized constructor

```java
package constructor;

public class Book {

        int length;
        int breadth;
        int height;
```

```java
        public Book(int length, int breadth, int height) {
                this.length = length;
                this.breadth = breadth;
                this.height = height;
        }

        public static void main(String[] args) {
                Book obj = new Book(10, 20, 30);
                System.out.println(obj.length);
                System.out.println(obj.breadth);
                System.out.println(obj.height);
        }
}
```

Key point to learn about constructor.

```java
package constructor;

public class Exemple2 {
        int i ;
        public Exemple2(int i) {
                this.i = i;
        }

        public static void main(String[] args) {
                Exemple2 obj = new Exemple2();
        }
}
```

```java
package constructor;

public class Example3 {
        int i;

        public Example3(int i) {
                this.i = i;
                System.out.println("Parameterized");
        }

        Example3() {
    System.out.println("default");
        }

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

```java
        Example3 obj = new Example3();
        Example3 obj1 = new Example3(5);
    }
}



package constructor;

public class Example4 {

    private Example4(){
        System.out.println("default");
    }

    public static void main(String[] args) {
        Example4 obj = new Example4();
    }
}

package constructor;

public class Example5 {

    void Example5(){
        System.out.println("default");
    }

    public static void main(String[] args) {
        Example5 obj = new Example5();
    }
}
```

How constructors are different from methods in Java?

- Constructor(s) must have the same name as the class within which it defined while it is not necessary for the method in java.
- Constructor(s) do not return any type while method(s) have the return type or **void** if does not return any value.
- Constructor is called only once at the time of Object creation while method(s) can be called any numbers of time.

package constructor;

```java
public class Example6 {

    Example6() {
        super();
    }

    public static void main(String[] args) {

    }

}



package constructor;

public class Example7 {

    Example7() {
        System.out.println("I am Example7()");
    }

    Example7(int i) {
        this();
        System.out.println("I am Example7(int i)");
    }

    public static void main(String[] args) {
        Example7 obj = new Example7(3);
    }
}




package constructor;

public class Example8 {
    Example8() {
        System.out.println("I am Example7()");
    }

    Example8(int i) {
        this();
        System.out.println("I am Example7(int i)");
    }

    Example8(int i, int j) {
```

```java
                this(5);
                System.out.println("I am Example8(int i,int j) ");
        }

        public static void main(String[] args) {
                Example8 obj = new Example8(3,6);
        }
}




package constructor;

public class Example9 {

        private String name;
        private int age;
        private String state;

        public Example9(){

        }
        public Example9(String name, int age, String state) {
                this.name = name;
                this.age = age;
                this.state = state;
        }

        public void display(){
                System.out.println("Example9 [name=" + name + ", age=" + age + ", state=" +
state + "]");
        }

        public static void main(String[] args) {

                Example9 obj2 = new Example9();
                obj2.display();

                Example9 obj = new Example9("test", 23, "B");
                obj.display();

                Example9 obj1 = new Example9("test1", 24, "A");
                obj1.display();
        }
}
```

```java
package constructor;

public class Example10 {

        private String name;
        private int age;
        private String state;

        public Example10(String name, int age, String state) {
                this.name = name;
                this.age = age;
                this.state = state;
        }

        public Example10(int age, String name, String state) {
                this.name = name;
                this.age = age;
                this.state = state;
        }

        public static void main(String[] args) {

        }

}
```

Static keyword in java

static is a non-access modifier in Java which is applicable for the following:
1. blocks
2. variables
3. methods
4. nested classes

To create a static member(block,variable,method,nested class), precede its declaration with the keyword *static*. When a member is declared static, it can be accessed before any objects of its class are created, and without reference to any object.

```java
package staticBlock;

public class Example1 {

    private static int a;

    public static void test1() {

    }

    static {
        System.out.println("this is sttaic block");
    }
}
```

Static Blocks

If you want to do some calculation in order to initialise the static variables, we can declare them in static block, and static block gets executed only once per class, when the class is first loaded.

```java
package staticBlock;

public class Example2 {

    static int i = 10;
    static int j;

    static {
        System.out.println("Static block initialized.");
        j = i * 2;
    }

    public static void main(String[] args) {
        System.out.println("Value of i : " + i);
        System.out.println("Value of j : " + j);
    }
}
```

Static Variable

When you declare variable as static, then only one copy of variable is created and shared among the object. Static variable is always class variable or global variable.

- We can create static variables at class-level only.
- static block and static variables are executed in order they are present in a program.

```java
package staticBlock;

public class Example3 {
	static int j = 80;

	public static void test() {
		int i = 90;
		System.out.println(i);
	}

	public static void test1() {
		static int i = 90;
		System.out.println(i);
	}

	public static void test2() {
		System.out.println(j);
	}
}

package staticBlock;

public class Example4 {

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

	static int i = 0;
	static {
		System.out.println("value of i=" + i);
		i = 90;
	}

	static {
		System.out.println("value of i=" + i);
	}

	public static void main(String[] args) {

	}
}
```

```java
package staticBlock;

public class Example5 {

        static int k = 90;

        void display() {
                System.out.println("value of k is:=" + k);
        }

        public static void main(String[] args) {
                Example5 obj = new Example5();

                obj.display();

                Example5 obj1 = new Example5();
                obj1.display();

                Example5 obj2 = new Example5();
                obj2.display();
        }

}
```

```java
package staticBlock;

public class Example6 {

        int i = 90;
        static int k = 80;
        static{
                k = 100;
                i = 60;
        }

}
```

Java Static Methods

Static Methods can access class variables(static variables) without using object(instance) of the class, however non-static methods and non-static variables can only be accessed using objects.
Static methods can be accessed directly in static and non-static methods.

```java
package staticBlock;

public class Example7 {

        static int i = 10;
        int b = 20;

        static void test1() {
                i = 20;
                System.out.println("from m1");
                b = 10;
                test2();
        }

        void test2() {
                i = 20;
                b = 10;
                System.out.println("from m2");
        }

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

```java
package staticBlock;

public class Example8 {

        static void test1(){
                System.out.println("test1()");
        }

        public static void main(String[] args) {
                test1();
        }
```

```
}


package staticBlock;

public class Example9 {

        static void test1(){
                System.out.println("test1()");
        }

        void test2(){
                System.out.println("test1()");
        }

        public static void main(String[] args) {
                test1();
                test2();
        }
}



package staticBlock;

public class Example10 {

        public static void main(String[] args) {
                Example9.test1();
        }
}
```

Static Class

A class can be made **static** only if it is a nested class.

1. Nested static class doesn't need reference of Outer class
2. A static class cannot access non-static members of the Outer class

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```java
package staticBlock;

public class Example11 {

        private static String str = "test";

        static class MyNestedClass {
                public void disp() {
                        System.out.println(str);
                }
        }

        public static void main(String[] args) {
                Example11.MyNestedClass obj = new Example11.MyNestedClass();
                obj.disp();
        }
}
```

```java
package staticBlock;

public class Example12 {
        private static String str = "test";

        class MyNestedClass {
                public void disp() {
                        System.out.println(str);
                }
        }

        public static void main(String[] args) {
                Example12.MyNestedClass obj = new Example12.MyNestedClass();
                obj.disp();
        }
}
```

```java
package staticBlock;

public class Example12 {
        private static String str = "test";
```

```
        class MyNestedClass {
                public void disp() {
                        System.out.println(str);
                }
        }

        public static void main(String[] args) {
                Example12.MyNestedClass obj = new Example12().new MyNestedClass();
                obj.disp();
        }
}
```

```
package staticBlock;

public static class Example13 {

        private static String str = "test";

        static class MyNestedClass {
                public void disp() {
                        System.out.println(str);
                }
        }
}
```

When we should use static variables and Methods

Use static variable when it is common to all object and change the value of variable by using static method. E.g. in college all student will have same college name

```
package staticBlock;

public class Student {

        private static String collegeName;
        private String studentName;
        private int rollnumber;
        private static int i;
```

```java
Student(String studentName) {
        this.studentName = studentName;
        this.rollnumber = increaseRollNumber();
}

public static String getCollegeName() {
        return collegeName;
}

public static void setCollegeName(String collegeName) {
        Student.collegeName = collegeName;
}

public static int increaseRollNumber() {
        return i++;
}

public void getStudentInformation() {
        System.out.print("student Name : " + this.studentName);
        System.out.print(" roll Number : " + this.rollnumber);
        System.out.print(" college Name : " + collegeName);
        System.out.println();
}

public static void main(String[] args) {
        Student.setCollegeName("LS college");

        Student obj = new Student("Ram");
        obj.getStudentInformation();
        Student obj1 = new Student("Mohan");
        obj1.getStudentInformation();
}

}
```
.

This keyword in java

There can be a lot of usage of **java this keyword**. In java, this is a **reference variable** that refers to the current object.

Usage of java this keyword

1. this can be used to refer current class instance variable.
2. this can be used to invoke current class method (implicitly)

3. this() can be used to invoke current class constructor.

4. this can be passed as an argument in the method call.

5. this can be passed as argument in the constructor call.

6. this can be used to return the current class instance from the method.

```java
package ThisExample;

public class Example1 {
        int rollno;
        String name;
        float fee;

        Example1(int rollno, String name, float fee) {
                rollno = rollno;
                name = name;
                fee = fee;
        }

        void display() {
                System.out.println(rollno + " " + name + " " + fee);
        }

        public static void main(String args[]) {
                Example1 s1 = new Example1(111, "ankit", 5000f);
                Example1 s2 = new Example1(112, "sumit", 6000f);
                s1.display();
                s2.display();
        }
}
```

```java
package ThisExample;

public class Example2 {
        int rollno;
        String name;
        float fee;

        Example2(int rollno, String name, float fee) {
                this.rollno = rollno;
                this.name = name;
                this.fee = fee;
```

```
        }

        void display() {
                System.out.println(rollno + " " + name + " " + fee);
        }

        public static void main(String args[]) {
                Example2 s1 = new Example2(111, "ankit", 5000f);
                Example2 s2 = new Example2(112, "sumit", 6000f);
                s1.display();
                s2.display();
        }
}


package ThisExample;

public class Example3 {

        void display() {
                this.show();

                System.out.println("Inside display function");
        }

        void show() {
                System.out.println("Inside show funcion");
        }

        public static void main(String args[]) {
                Example3 t1 = new Example3();
                t1.display();
        }
}


package ThisExample;

public class Example4 {
        int a;
        int b;

        Example4() {
                this(10, 20);
                System.out.println("Inside  default constructor \n");
```

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```java
        }

        Example4(int a, int b) {
                this.a = a;
                this.b = b;
                System.out.println("Inside parameterized constructor");
        }

        public static void main(String[] args) {
                Example4 object = new Example4();
        }
}




package ThisExample;

public class Example5 {
        void m(Example5 obj) {
                System.out.println("method is invoked");
        }

        void p() {
                m(this);
        }

        public static void main(String args[]) {
                Example5 s1 = new Example5();
                s1.p();
        }
}




package ThisExample;

public class Example6 {

        Example7 obj;

        Example6(Example7 obj) {
                this.obj = obj;
                obj.display();
        }
}
```

```java
package ThisExample;

public class Example7 {

        int i = 90;

        Example7() {
                Example6 obj = new Example6(this);
        }

        void display() {
                System.out.println("Value of i in Class Example7 : " + i);
        }

        public static void main(String[] args) {
                Example7 obj = new Example7();

        }
}




package ThisExample;
public class Example8 {
        int a;
        int b;

        Example8() {
                a = 10;
                b = 20;
        }

        Example8 get() {
                return this;
        }

        void display() {
                System.out.println("a = " + a + "  b = " + b);
        }

        public static void main(String[] args) {
                Example8 object = new Example8();
                object.get().display();
        }
}
```

Inheritance in Java

As we know, a child inherits the properties from his parents. A similar concept is followed in Java, where we have two classes:

1. Parent class (Super or Base class)

2. Child class (Subclass or Derived class)

A class which inherits the properties is known as Child Class whereas a class whose properties are inherited is known as Parent class.

Inheritance represents the IS-A relationship which is also known as a *parent-child* relationship.

Why use inheritance in java

- o For Method Overriding (so runtime polymorphism can be achieved).
- o For Code Reusability.

Syntax

package inheritance;

public class Example2 **extends** Example1{

}

Types of inheritance in java

1. **Single level Inheritance**

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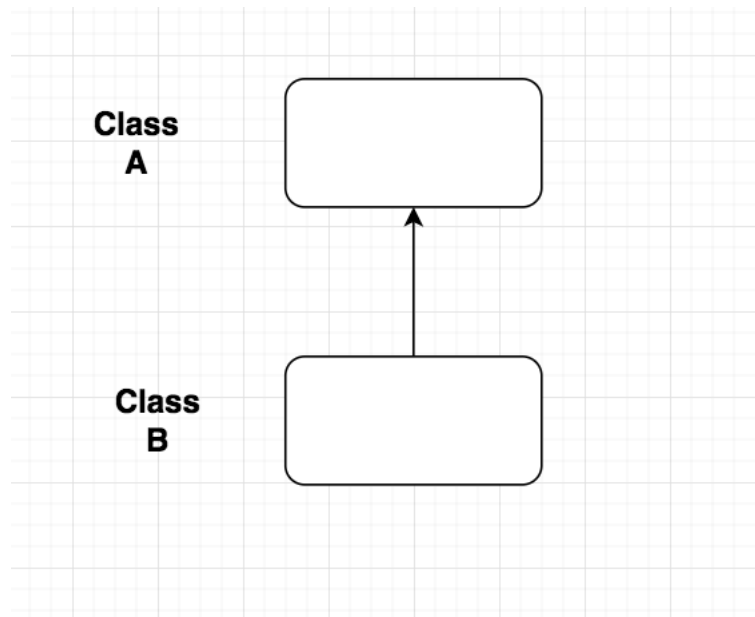
Class
A

Class
B

2. **Multilevel Inheritance**
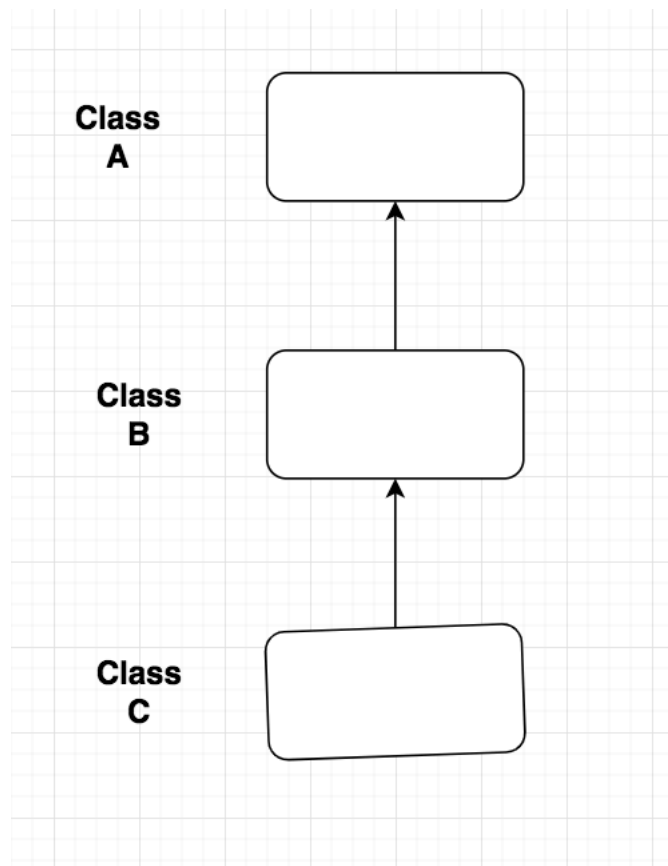
3. Hierarchical Level Inheritance

Class A
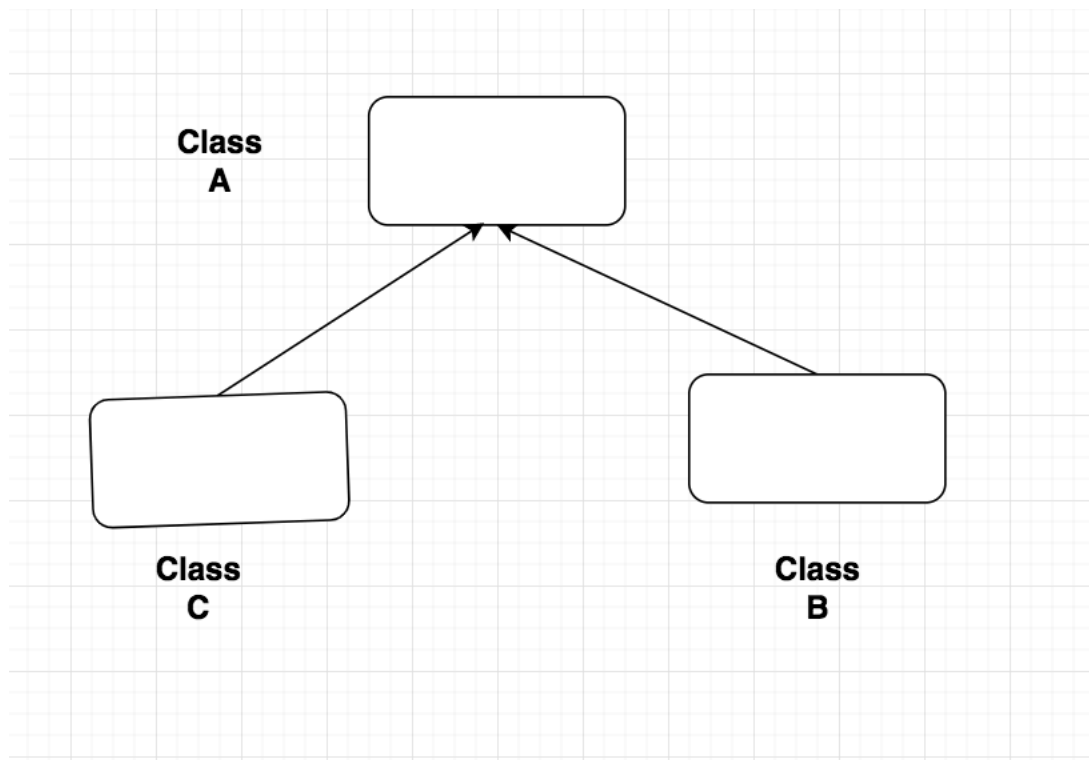
Class C

Class B

package inheritance;

public class Student {

       private String Schooladdress;

       private String SchoolName;

       public String getSchooladdress() {
           return "Muzaffarpur Bihar 560100";
       }

       public String getSchoolName() {
           return "DAV";
       }
}

package inheritance;

```java
public class Ram extends Student{

        int roolnumber;

        public Ram(int roolnumber) {
                this.roolnumber = roolnumber;
        }

        public void display() {
                String s1 = "Ram [roolnumber=" + roolnumber + ", getSchooladdress()=" +
getSchooladdress() + ", getSchoolName()="
                                + getSchoolName() + "]";
                System.out.println(s1);
        }

        public static void main(String[] args) {
                Ram ram = new Ram(8);
                ram.display();
        }
}



package inheritance;

public class Teacher {

        String designation = "Teacher";
        String collegeName = "L.S College Muzaffarpur";

        void does() {
                System.out.println("Teaching");
        }
}



package inheritance;

public class JavaTeacher extends Teacher {

        String mainSubject = "Spark";

        public static void main(String args[]) {
                JavaTeacher obj = new JavaTeacher();
                System.out.println(obj.collegeName);
                System.out.println(obj.designation);
                System.out.println(obj.mainSubject);
```

```java
            obj.does();
    }
}
```

Multilevel Inheritance

```java
package inheritance;

public class College {

        public String collegeName = "LS COLLEGE";

}



package inheritance;

public class ClassRoom extends College{

        public String classRoom = "10Th";
}



package inheritance;

public class Students extends ClassRoom {

        int age;
        String name;

        public Students(int age, String name) {
                this.age = age;
                this.name = name;
        }

        public static void main(String[] args) {
                Students students = new Students(10, "Mohan");
                System.out.println(students);
                Students students1 = new Students(10, "RAM");
                System.out.println(students1);
                Students students2 = new Students(10, "SOHAN");
                System.out.println(students2);
        }
}
```

```java
        @Override
        public String toString() {
                return "Students [age=" + age + ", name=" + name + ", classRoom=" +
classRoom + ", collegeName=" + collegeName
                                        + "]";
        }
}
```

Hierarchical level inheritance

```java
package inheritance;

public class Vehicle {

        int speed;

        public void speed(int speed){
                this.speed = speed;
                System.out.println("Vehicle runts at:="+speed+"KM/H");
        }
}
```

```java
package inheritance;

public class Car extends Vehicle{

        int price;

        String name;

        public Car(int price, String name) {
                this.price = price;
                this.name = name;
        }

        public static void main(String[] args) {
                Car car = new Car(2000,"Maruti");
                car.speed(10);
                System.out.println(car);
        }

        @Override
        public String toString() {
                return "Car [price=" + price + ", name=" + name + ", speed=" + speed + "]";
```

```java
        }
}


package inheritance;

public class Jeep extends Vehicle{

        int price;

        String name;

        public Jeep(int price, String name) {
                this.price = price;
                this.name = name;
        }

        public static void main(String[] args) {
                Jeep jeep = new Jeep(1000,"Jeep");
                jeep.speed(100);
                System.out.println(jeep);
        }

        @Override
        public String toString() {
                return "Jeep [price=" + price + ", name=" + name + ", speed=" + speed + "]";
        }

}
```

Why multiple inheritance is not supported in java?

```java
package inheritance;

public class Example3 {

        void msg(){

        }
}

package inheritance;

public class Example4 {
```

```java
        void msg() {

        }
}

package inheritance;

public class Example6 extends Example3,Example3{

}
```

- **Private members do NOT get inherited.**
- **Constructors cannot be Inherited in Java.**

```java
package inheritance;

public class Conts1 {

        int a;

        public Conts1(int a) {
                this.a = a;
        }

        Conts1() {

        }
}

package inheritance;

public class Conts2 extends Conts1{

        public static void main(String[] args) {
                Conts2 conts2 = new Conts2(4);
        }
}
```

Aggregation in Java

Aggregation in Java is a relationship between two classes that is best described as a "has-a" and "whole/part" relationship. ... The **aggregate** class contains a reference to another class and is said to have ownership of that class. Each class referenced is considered to be part-of the **aggregate** class.

Aggregation represents HAS-A relationship.

```java
package inheritance;

public class Operation {

        int square(int n) {
                return n * n;
        }

        int circle(int radious) {
                return (22 / 7) * radious;
        }

        int rectangle(int length,int width) {
                return width*length;
        }

}
```

```java
package inheritance;

public class Circle {

        Operation operation;

        public void calculateArea(int area){
                operation = new Operation();
                int a = operation.square(area);
                System.out.println("Circle area="+a);
        }

        public static void main(String[] args) {

                Circle circle = new Circle();
                circle.calculateArea(5);
        }

}
```

When to use Aggregation?
- Code reuse is also best achieved by aggregation when there is no is-a relationship.

- Inheritance should be used only if the relationship is-a is maintained throughout the lifetime of the objects involved; otherwise, aggregation is the best choice.

Understanding meaningful example of Aggregation

Employee has an object of Address, address object contains its own informations such as city, state, country etc. In such case relationship is Employee HAS-A address.

```java
package inheritance;

public class Address {

        String city, state, country;

        public Address(String city, String state, String country) {
                this.city = city;
                this.state = state;
                this.country = country;
        }
}
```

```java
package inheritance;

public class Employee {

        int id;
        String name;
        Address address;

        public Employee(int id, String name, Address address) {
                this.id = id;
                this.name = name;
                this.address = address;
        }

        void display() {
                System.out.println(id + " " + name);
                System.out.println(address.city + " " + address.state + " " + address.country);
        }

        public static void main(String[] args) {
                Address address1 = new Address("test1", "BIHAR", "india");
                Address address2 = new Address("test2", "BIHAR", "india");
```

```
                Employee e = new Employee(11, "Ram", address1);
                Employee e2 = new Employee(12, "Mohan", address2);

                e.display();
                e2.display();

        }
}
```

Java Polymorphism

Method Overloading is a feature that allows a class to have more than one method having the same name, if their argument lists are different. It is similar to constructor overloading in Java, that allows a class to have more than one constructor having different argument lists.

How to perform method overloading in Java?

package methodOverloading;

public class Overloading1 {

```java
        private static void display(int a) {
                System.out.println("Arguments: " + a);
        }

        private static void display(int a, int b) {
                System.out.println("Arguments: " + a + " and " + b);
        }

        public static void main(String[] args) {
                display(1);
                display(1, 4);
        }
}
```

By changing the datatype of parameters

```java
package methodOverloading;

public class Overloading2 {

        private static void display(int a) {
                System.out.println("Got Integer data.");
        }

        private static void display(String a) {
                System.out.println("Got String object.");
        }

        public static void main(String[] args) {
                display(1);
                display("Hello");
        }
}
```

```java
package methodOverloading;

public class Overloading3 {

        private String formatNumber(int value) {
                return String.format("%d", value);
        }

        private String formatNumber(double value) {
                return String.format("%.3f", value);
        }

        private String formatNumber(String value) {
                return String.format("%.2f", Double.parseDouble(value));
        }

        public static void main(String[] args) {
                Overloading3 hs = new Overloading3();
                System.out.println(hs.formatNumber(500));
                System.out.println(hs.formatNumber(89.9934));
                System.out.println(hs.formatNumber("550"));
        }
}
```

%f	Decimal floating-point
%d	Decimal integer

Important Points

- Two or more methods can have same name inside the same class if they accept different arguments. This feature is known as method overloading.
- Method overloading is achieved by either:
  - changing the number of arguments.
  - or changing the datatype of arguments.
- Method overloading is not possible by changing the return type of methods.

Why method overloading?

Suppose, you have to perform addition of the given numbers but there can be any number of arguments (let's say either 2 or 3 arguments for simplicity).

In order to accomplish the task, you can create two methods sum1num(int, int) and sum2num(int, int, int) for two and three parameters respectively. However, other programmers as well as you in future may get confused as the behaviour of both methods is same but they differ by name.

The better way to accomplish this task is by overloading methods. And, depending upon the argument passed, one of the overloaded methods is called. This helps to increase readability of the program

Why Method Overloading is not possible by changing the return type of method only?

```
.  package methodOverloading;

public class Overloading4 {

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

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

```
        }
}

class TestOverloading3 {
        public static void main(String[] args) {
                System.out.println(Adder.add(11, 11));// ambiguity
        }
}
```

Compile Time Error: method add(int,int) is already defined in class Overloading4

Can we overload java main() method?

Yes, by method overloading. You can have any number of main methods in a class by method overloading. But JVM calls main() method which receives string array as arguments only

```
package methodOverloading;

public class Overloading5 {

        public static void main(String[] args) {
                System.out.println("main with String[]");
        }

        public static void main(String args) {
                System.out.println("main with String");
        }

        public static void main() {
                System.out.println("main without args");
        }
}


package methodOverloading;

public class Overloading6 {

        void sum(int a, long b) {
                System.out.println(a + b);
        }
```

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https://www.udemy.com/seleniumbybhanu/

```java
        void sum(int a, int b, int c) {
                System.out.println(a + b + c);
        }

}
```

Method Overloading with Type Promotion in case of ambiguity

```java
package methodOverloading;

public class Overloading7 {

        void sum(int a, long b) {
                System.out.println("a method invoked");
        }

        void sum(long a, int b) {
                System.out.println("b method invoked");
        }

        public static void main(String args[]) {
                Overloading7 obj = new Overloading7();
                obj.sum(20, 20);
        }
}
```

When parent class has only parameterised constructor Then child class has to explicitly call the parent class parameterised constructor.

```java
package methodOverloading;

public class Overloading8 {

        Overloading8(int i) {

        }
}
```
```java
package methodOverloading;

public class Overloading9 extends Overloading8 {

        Overloading9(int i) {
                super(i);
```

```
        }

        public static void main(String[] args) {

        }
}
```

When parent class has parameterised and default constructor Then child class has not explicitly call to the parent class constructor. Since Java compiler will keep spuer() as first line of constructor.

```
package methodOverloading;

public class Overloading10 {

        Overloading10(int i) {

        }

        Overloading10() {

        }
}
package methodOverloading;

public class Overloading11 extends Overloading10{

        Overloading11(){

        }

}
```

Method Overriding in Java

If subclass (child class) has the same method as declared in the parent class, it is known as method overriding in Java.

Usage of Java Method Overriding

1. Method overriding is used to provide the specific implementation of a method which is already provided by its superclass.

2. Method overriding is used for runtime polymorphism

Rules for Java Method Overriding
1. The method must have the same parameter as in the parent class.
2. The method must have the same name as in the parent class
3. There must be an IS-A relationship (inheritance).

```java
package methodOverriding;

public class Overriding1 {

        public void test(){
                System.out.println("This is test implementation");
        }

        public void test1(){
                System.out.println("This is test implementation test1");
        }

}
```

```java
package methodOverriding;

public class Overriding2 extends Overriding1{

        public void test(){
                System.out.println("This is test implementation-1");
        }

        public static void main(String[] args) {
                Overriding2 Overriding2 = new Overriding2();
                Overriding2.test();

                Overriding2.test1();
        }
}
```

```java
package methodOverriding;

public class Vehicle {
```

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```java
        public void run() {
                System.out.println("runs at 80KM/H");
        }
}
package methodOverriding;

public class Car extends Vehicle{

        public void run(){
                System.out.println("runs at 180KM/H");
        }
}
package methodOverriding;

public class Jeep extends Vehicle{

}
package methodOverriding;

public class Bike extends Vehicle{

}



package methodOverriding;

public class Bank {

        public int rateOfInterest(){
                System.out.println("rateOfInterest= 0%");
                return 0;
        }
}
package methodOverriding;

public class HDFCBank extends Bank {

        public int rateOfInterest() {
                System.out.println("rateOfInterest= 8.5%");
                return 0;
        }
}
```

```
package methodOverriding;

public class ICICI extends Bank{

}
```

```
package methodOverriding;

public class SBI extends Bank {

        public int rateOfInterest() {
                System.out.println("rateOfInterest= 7.5%");
                return 0;
        }
}
```

Can we override static method?

No, Since static members are class members.

It is because the static method is bound with class whereas instance method is bound with an object. Static belongs to the class area, and an instance belongs to the heap area.

```
package methodOverriding;

public class Example1 {

        private static void test1() {
                System.out.println("Example1");
        }

        private static void test2() {
                System.out.println("Example1 test2");
        }
}
```

```
package methodOverriding;

public class Example2 extends Example1 {

        private static void test1() {
                System.out.println("Example2");
        }
```

```
public static void main(String[] args) {
        Example2.test1();

        // Example2.test2();
    }
}
```

Can we override java main method?

No, because the main is a static method.

Cam we Override private methods?

No, Because private is only to class.

Interface in Java

Points to remember

- You cannot instantiate an interface.

- An interface does not contain any constructors.

- All of the methods in an interface are abstract.

- An interface fields that can appear in an interface must be declared both static and final.

```
package interfaceInjava;

public interface A {

    int i = 90;
    public static final int j = 80;

    void test1();

    void test2();
}
```

- An interface is not extended by a class; it is implemented by a class.

- An interface can extend multiple interfaces.

- All the methods are public and abstract. And all the fields are public, static, and final.
- It is used to achieve multiple inheritance.

```
package interfaceInjava;

public interface A {

}

public class B implements A {

}
```
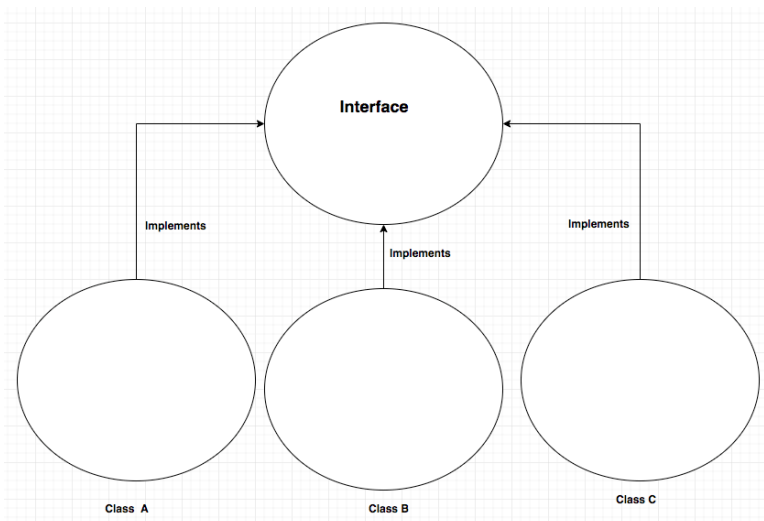

New features added in interfaces in JDK 8

1. Prior to JDK 8, interface could not define implementation. We can now add default implementation for interface methods. This default implementation has special use and does not affect the intention behind interfaces.
   Suppose we need to add a new function in an existing interface. Obviously the old code will not work as the classes have not implemented those new functions. So with

the help of default implementation, we will give a default body for the newly added functions. Then the old codes will still work.

2. Another feature that was added in JDK 8 is that we can now define static methods in interfaces which can be called independently without an object. Note: these methods are not inherited.

```java
package interfaceInjava;

public interface A {
    // in java 8

    default int test3() {
        return 0;
    }

    default void test4() {
    }

    static void test5() {

    }
}
```

New features added in interfaces in JDK 9
From Java 9 onwards, interfaces can contain following also
  1. Static methods
  2. Private methods
  3. Private Static methods

Syntax

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```
package interfaceInjava;

public interface Example1 {

        int i = 90;

        void test1();

}
```

To implement an interface we use keyword: implement

```
package interfaceInjava;

public interface Example2 {

        int i = 90;

        void test1();

        void test2();
}

package interfaceInjava;

public class ImplementExample2 implements Example2{

        @Override
        public void test1() {
                // TODO Auto-generated method stub

        }

        @Override
        public void test2() {
                // TODO Auto-generated method stub

        }

}
```

An interface does not contain any constructors.

```java
package interfaceInjava;

public interface Example3 {


    Example3(){

    }
}
```

An interface cannot contain instance fields. The only fields that can appear in an interface must be declared both static and final.

```java
package interfaceInjava;

public interface Example4 {

    Example4 example4;

    int i;

}
```

An interface can extend multiple interfaces.

```java
package interfaceInjava;

public interface Example5 {

    void method5();
}
```

```java
package interfaceInjava;

public interface Example6 {

    void method6();
}
```

```java
package interfaceInjava;
```

```java
public interface Example7 extends Example5, Example6{

}
```

Default and static method in interface

```java
package interfaceInjava;

public interface Example8 {

    void method6();

    default void test1() {
        System.out.println("I am test1");
    }

    static void test2() {
        System.out.println("I am test2");
    }
}
```

When class implements interface which extends more than one interface.

```java
package interfaceInjava;

public interface Example5 {

    void method5();
}
```

```java
package interfaceInjava;

public interface Example6 {

    void method6();
}
```

```java
package interfaceInjava;
```

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```java
public interface Example7 extends Example5, Example6{

}
package interfaceInjava;

public class TestExample7 implements Example7{

        @Override
        public void method5() {
                // TODO Auto-generated method stub

        }

        @Override
        public void method6() {
                // TODO Auto-generated method stub

        }

}
```

Interface Real Time Example

```java
package interfaceInjava;

public interface Vehicle {

        void changeGear(int a);

        void speedUp(int a);

        void applyBrakes(int a);
}

package interfaceInjava;

public class Car implements Vehicle {

        int speed;
        int gear;

        @Override
        public void changeGear(int a) {
                gear = a;
```

```java
        }

        @Override
        public void speedUp(int a) {

                speed = a;
        }

        @Override
        public void applyBrakes(int a) {

                speed = speed - a;
        }

        public void display() {
                System.out.println("speed: " + speed + " gear: " + gear);
        }
}

package interfaceInjava;

public class Bike implements Vehicle {

        int speed;
        int gear;

        @Override
        public void changeGear(int a) {
                gear = a;
        }

        @Override
        public void speedUp(int a) {

                speed = a;
        }

        @Override
        public void applyBrakes(int a) {

                speed = speed - a;
        }

        public void display() {
```

```java
            System.out.println("speed: " + speed + " gear: " + gear);
        }

    }

    package interfaceInjava;

    public class TestVehicle {

        public static void main(String[] args) {

            Car car = new Car();
            car.changeGear(3);
            car.speedUp(4);
            car.applyBrakes(1);

            System.out.println("Bicycle present state:");
            car.display();

            Bike bike = new Bike();
            bike.changeGear(2);
            bike.speedUp(4);
            bike.applyBrakes(1);

            System.out.println("Bike present state:");
            bike.display();
        }

    }
```

Java 8 Interface Features

From Java 8, apart from public abstract methods, you can have public static methods and public default methods.

```java
package interfaceInjava;

public interface Exampl3 {

    default void test1(){
        System.out.println("I am default");
    }

    static void test2(){
```

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```java
            System.out.println("I am static");
        }

}

package interfaceInjava;

public class Exampl3Test implements Exampl3{

        public static void main(String[] args) {
                Exampl3.test2();

                Exampl3Test obj = new Exampl3Test();
                obj.test1();
        }

}
```

Private methods since java 9
Since java 9, you will be able to add private methods and private static method in interfaces.

These private methods will improve code re-usability inside interfaces. Foe example, if two default methods needed to share code, a private interface method would allow them to do so, but without exposing that private method to it's implementing classes.

Using private methods in interfaces have four rules :

Private interface method cannot be abstract.
Private method can be used only inside interface.
Private static method can be used inside other static and non-static interface methods.
Private non-static methods cannot be used inside private static methods.

```java
public interface CustomInterface {

  public abstract void method1();

  public default void method2() {
    method4();  //private method inside default method
    method5();  //static method inside other non-static method
    System.out.println("default method method2()");
  }

  public static void method3() {
    method5(); //static method inside other static method
```

```java
            System.out.println("static method method3()");
        }

        private void method4(){
            System.out.println("private method method4()");
        }

        private static void method5(){
            System.out.println("private static method method5()");
        }
    }

    public class CustomClass implements CustomInterface {

        @Override
        public void method1() {
            System.out.println("abstract method");
        }

        public static void main(String[] args){
            CustomInterface instance = new CustomClass();
            instance.method1();
            instance.method2();
            CustomInterface.method3();
        }
    }
```

Abstract classes

1. An abstract class is a class that is declared with abstract keyword.
2. An abstract method is a method that is declared without an implementation.
3. An abstract class may or may not have all abstract methods. Some of them can be concrete methods
4. A method defined abstract must always be redefined in the subclass, thus making overriding compulsory OR either make subclass itself abstract.
5. Any class that contains one or more abstract methods must also be declared with abstract keyword.
6. There can be no object of an abstract class. That is, an abstract class cannot be directly instantiated with the *new operator*.
7. An abstract class can have parametrized constructors and default constructor is always present in an abstract class.

Syntax

```java
package abstractInJava;

public abstract class Example1 {

        void test1() {

        }

        abstract void test2();

}
```

Abstract members are not by default public static final

```java
package abstractInJava;

public abstract class Example2 {

        int i = 80;

        public static final int j = 40;

        abstract void test1();

        public abstract void test2();

}
```

Use of abstract class

```java
package abstractInJava;

public abstract class Person {

        private String name;
        private String gender;

        public Person(String nm, String gen) {
                this.name = nm;
                this.gender = gen;
```

```java
        }

        public abstract void work();

        @Override
        public String toString() {
                return "Name=" + this.name + "::Gender=" + this.gender;
        }

        public void changeName(String newName) {
                this.name = newName;
        }
}


package abstractInJava;

public class Employee extends Person {

        private int empId;

        public Employee(String nm, String gen, int id) {
                super(nm, gen);
                this.empId = id;
        }

        @Override
        public void work() {
                if (empId == 0) {
                        System.out.println("Not working");
                } else {
                        System.out.println("Working as employee");
                }
        }

        public static void main(String args[]) {
                Person student = new Employee("Test1", "Female", 0);
                Person employee = new Employee("Test2", "Male", 12);
                student.work();
                employee.work();
                employee.changeName("Test3");
                System.out.println(employee.toString());
        }

}
```

Can we extend more than one abstract class?

Ans: NO

Why can't we create the object of an abstract class?

Because these classes are incomplete, they have abstract methods that have no body so if java allows you to create object of this class then if someone calls the abstract method using that object then What would happen? There would be no actual implementation of the method to invoke.
Also because an object is concrete. An abstract class is like a template, so you have to extend it and build on it before you can use it.

Can we create constructor in abstract class

Ans: Yes

```
package abstractInJava;

public abstract class Example3 {

	int i;

	String name;

	public Example3(int i, String name) {
		this.i = i;
		this.name = name;
	}

	Example3() {

	}
}
```

Abstract Vs Interface

Abstract class	Interface
1) Abstract class can **have abstract and non-abstract**methods.	Interface can have **only abstract** methods. Since Java 8, it can have **default and static methods** also.
2) Abstract class **doesn't support multiple inheritance**.	Interface **supports multiple inheritance**.
3) Abstract class **can have final, non-final, static and non-static variables**.	Interface has **only static and final variables**.
4) Abstract class **can provide the implementation of interface**.	Interface **can't provide the implementation of abstract class**.
5) The **abstract keyword** is used to declare abstract class.	The **interface keyword** is used to declare interface.
6) An **abstract class** can extend another Java class and implement multiple Java interfaces.	An **interface** can extend another Java interface only.
7) An **abstract class** can be extended using keyword "extends".	An **interface** can be implemented using keyword "implements".
8) A Java **abstract class** can have class members like private, protected, etc.	Members of a Java interface are public by default.

9)**Example:**
 public abstract class Shape{
 public abstract void draw();
 }
	Example:
	 public interface Drawable{
	 void draw();
	 }

Abstract Classes Compared to Interfaces

Abstract classes are similar to interfaces. You cannot instantiate them, and they may contain a mix of methods declared with or without an implementation. However, with abstract classes, you can declare fields that are not static and final, and define public, protected, and private concrete methods. With interfaces, all fields are automatically public, static, and final, and all methods that you declare or define (as default methods) are public. In addition, you can extend only one class, whether or not it is abstract, whereas you can implement any number of interfaces.

Which should you use, abstract classes or interfaces?

- Consider using abstract classes if any of these statements apply to your situation:
  - You want to share code among several closely related classes.
  - You expect that classes that extend your abstract class have many common methods or fields, or require access modifiers other than public (such as protected and private).
  - You want to declare non-static or non-final fields. This enables you to define methods that can access and modify the state of the object to which they belong.
- Consider using interfaces if any of these statements apply to your situation:
  - You expect that unrelated classes would implement your interface. For example, the interfaces Comparable and Cloneable are implemented by many unrelated classes.
  - You want to specify the behaviour of a particular data type, but not concerned about who implements its behaviour.
  - You want to take advantage of multiple inheritance of type.

Example

```java
package interfaceInjava;

public class Eample100 implements Example101 {

    @Override
    public void test1() {

    }

    public void test5() {
```

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```java
        }

        public static void main(String[] args) {
                Example101 obj = new Eample100();

                obj.test1();
                obj.test2();
                obj.test3();

                Example102 obj1 = new Eample100();
                obj1.test3();

                Eample100 obj2 = new Eample100();
                obj2.test5();

        }

        @Override
        public void test3() {
                // TODO Auto-generated method stub

        }

}
package interfaceInjava;

public interface Example101 extends Example102{

        void test1();

        default void test2(){
                System.out.println("default method");
        }
}
package interfaceInjava;

public interface Example102 {

        void test3();
}
```

Access Modifier

	With In Class Same package	Outside Class Same package	Outside Class Different package Without Inheritance	Outside Class Different package Using Inheritance
Private	YES	NO	NO	NO
public	YES	YES	YES	YES
protected	YES	YES	NO	YES
default	YES	YES	NO	NO

```
package accessmodifier;

public class Example1 {

    public String s1;

    private String s2;

    protected String s3;

    String s4;

    protected void name1() {
        System.out.println("protected method");
    }
}
```

```java
    public void name2() {
            System.out.println("public method");
    }

    private void name3() {
            System.out.println("private method");
    }

    void name4() {
            System.out.println("default method");
    }

}
```

What are the members we can access in different class, within same package?

```java
package accessmodifier;

public class Example2 {

    public static void main(String[] args) {

            Example1 example1 = new Example1();

            example1.name1();
            example1.name2();
            example1.name4();

            System.out.println(example1.s1);
            System.out.println(example1.s3);
            System.out.println(example1.s4);
    }

}
```
What are the members we can access in different class, in different package?

```java
package access.modifier.test;

import accessmodifier.Example1;

public class Example3 {

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

```
        Example1 example1 = new Example1();

        example1.name2();

        System.out.println(example1.s1);
    }

}
```

What are the members we can access in different class, in different package through inheritance?

```
package access.modifier.test;

import accessmodifier.Example1;

public class Example4 extends Example1{

    public static void main(String[] args) {
        Example4 example4 = new Example4();
        example4.name1();
        example4.name2();

        System.out.println(example4.s1);
        System.out.println(example4.s3);
    }

}
```

Java Enum

Enum in java is a data type that contains fixed set of constants.

It can be used for days of the week (SUNDAY, MONDAY, TUESDAY, WEDNESDAY, THURSDAY, FRIDAY and SATURDAY) , directions (NORTH, SOUTH, EAST and WEST) etc. The java enum constants are static and final implicitly.

Points to remember for Java Enum

- enum improves type safety
- enum can be easily used in switch
- enum can be traversed
- enum can have fields, constructors and methods
- enum may implement many interfaces but cannot extend any class because it internally extends Enum class

Enum can be transversed

```java
package enumjava;

public class Example1 {

    public enum Season {
        WINTER, SPRING, SUMMER, FALL
    }

    public static void main(String[] args) {
        for (Season s : Season.values())
            System.out.println(s);

    }
}
```

Value to the enum constants

```java
package enumjava;

public class Example2 {

    enum Season {
        WINTER(5), SPRING(10), SUMMER(15), FALL(20);

        private int value;

        private Season(int value) {
            this.value = value;
        }
    }
```

```java
        public static void main(String args[]) {
                for (Season s : Season.values())
                        System.out.println(s + " " + s.value);


        }
}
```

Switch Case call based on enum constant

```java
package enumjava;

public enum Operation {
        PLUS, MINUS, TIMES, DIVIDE;

        double calculate(double x, double y) {
                switch (this) {
                case PLUS:
                        return x + y;
                case MINUS:
                        return x - y;
                case TIMES:
                        return x * y;
                case DIVIDE:
                        return x / y;
                default:
                        throw new AssertionError("Unknown operations " + this);
                }
        }

}
```

```java
package enumjava;

public class TestOperation {
        public static void main(String[] args) {

                double result = Operation.PLUS.calculate(1, 3);
                System.out.println(result);

                result = Operation.MINUS.calculate(1, 3);
```

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

How to get single Data from enum constant

```java
package enumjava;

public enum State {

        BIHAR(100, "Hindi", "Bjp"), UP(1000, "Hindi", "Bjp"), MP(100, "Hindi", "Congress"),
GOA(100, "Hindi", "Test");

        State(int population, String language, String party) {

        }

        public static String getLanguage(State state) {

                State[] values = state.values();

                for (State state2 : values) {
                        if (state2.equals(state)) {
                                values = State.values();
                                return values[2].name();
                        }
                }
                return null;
        }
}
```

```java
package enumjava;

public class TestState {

        public static void main(String[] args) {

                String data = State.getLanguage(State.BIHAR);

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

Type conversion in Java with Examples

When you assign value of one data type to another, the two types might not be compatible with each other. If the data types are compatible, then Java will perform the conversion automatically known as Automatic Type Conversion and if not then they need to be casted or converted explicitly. For example, assigning an int value to a long variable.

Widening or Automatic Type Conversion
Widening conversion takes place when two data types are automatically converted. This happens when:

- The two data types are compatible.
- When we assign value of a smaller data type to a bigger data type.

For Example, in java the numeric data types are compatible with each other but no automatic conversion is supported from numeric type to char or Boolean. Also, char and Boolean are not compatible with each other.

Byte-->Short-->Int-->Long-->Float-->Double (**Widening or Automatic Type Conversion**)

```
package enumjava;

public class TypeCastingExample1 {

        public static void main(String[] args) {
                int i = 200;

                long l = i;

                float f = l;

                double d = i;

                System.out.println("Int value " + i);
                System.out.println("Long value " + l);
                System.out.println("Float value " + f);
                System.out.println("Double value " + d);
        }
}
```

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Explicit Conversion

If we want to assign a value of larger data type to a smaller data type we perform explicit type casting or narrowing.

- This is useful for incompatible data types where automatic conversion cannot be done.
- Here, target-type specifies the desired type to convert the specified value to.

Double--→Float--→Long--→Int--→Short--→Byte (**Narrowing or Explicit Conversion**)

```java
package typeCasting;

public class TypeCastingExample2 {

    public static void main(String[] args) {
        double d = 300.09;

        long l = (long) d;

        int i = (int) l;

        short b = (short)d;

        System.out.println("Double value " + d);

        System.out.println("Long value " + l);

        System.out.println("Int value " + i);

        System.out.println("Short value " + b);
    }
}
```

Convert Int and double to byte

Byte Class which is used to return number of bits required to represent a byte value in binary representation (two's complement).

When we do Byte. SIZE It returns a int value equal to 8.

```java
package typeCasting;

public class TypeCastingExample3 {

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

```java
        byte b;
        int i = 259;
        double d = 412.142;

        System.out.println("Convert int to byte.");

        b = (byte) i;
        System.out.println("i = " + i + " b = " + b);

        System.out.println("Convert double to byte.");
        b = (byte) d;
        System.out.println("d = " + d + " b= " + b);
    }
}




package typeCasting;

public class A {

    public void test2(){
        System.out.println("test1");
    }

}




package typeCasting;

public class B extends A {

    public void test1() {
        System.out.println("test1");
    }

    public static void main(String[] args) {
        A obj = new B();

        obj.test2();

        A obj1 = new B();

        ((B) obj1).test1();
```

```
        }

}
```

Type promotion in Expressions

While evaluating expressions, the intermediate value may exceed the range of operands and hence the expression value will be promoted. Some conditions for type promotion are:

1. Java automatically promotes each byte, short, or char operand to int when evaluating an expression.
2. If one operand is a long, float or double the whole expression is promoted to long, float or double respectively.

```java
package typeCasting;

public class TypeCastingExample4 {

        public static void main(String args[]) {
                byte b = 47;
                char c = 'b';
                short s = 1026;
                int i = 80000;
                float f = 8.67f;
                double d = .923;

                double result = (f * b) + (i / c) - (d * s);

                System.out.println("result = " + result);
        }
}
```

Final Keyword In Java

The **final keyword** in java is used to restrict the user. The java final keyword can be used in many context. Final can be:

1. variable
2. method

3. class

The final keyword can be applied with the variables, a final variable that have no value it is called blank final variable or uninitialized final variable. It can be initialized in the constructor only. The blank final variable can be static also which will be initialized in the static block only.

1) Java final variable

If you make any variable as final, you cannot change the value of final variable(It will be constant).

```java
package finalInJava;

public class Example1 {

        final int speedlimit = 100;

        void run() {
                speedlimit = 400; // Compile Time error
        }

        public static void main(String args[]) {
                Example1 obj = new Example1();
                obj.run();
        }
}
```

2) Java final method

If you make method as final , we can't override

```java
package finalInJava;

public class Example2 {

        final void test1(){

        }
}
```

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```java
package finalInJava;

public class Example3 extends Example2{

        final void test1() {

        }

}
```

3) Java Final Class

When we make class as final class we can't extend

```java
package finalInJava;

public final class Example4 {

}
```
```java
package finalInJava;

public class Example5 extends Example4{

}
```

4) Can we Inherit final method

Yes, But we can't override

What is blank or uninitialized final variable?

A final variable that is not initialized at the time of declaration is known as blank final variable.

If you want to create a variable that is initialized at the time of creating object and once initialized may not be changed, it is useful. For example PAN CARD number of an employee.

It can be initialized only in constructor.

```java
package finalInJava;

public class Example6 {
```

```java
        int id;
        String name;
        final String PAN_CARD_NUMBER;

        Example6(String panNumber) {
                this.PAN_CARD_NUMBER = panNumber;
        }

}
```

Can we re-initialize the final variables
Ans:- No

```java
package finalInJava;

public class Example6 {

        int id;
        String name;
        final String PAN_CARD_NUMBER="123";

        Example6(String panNumber) {
                this.PAN_CARD_NUMBER = panNumber;
        }
}
```

Can we initialize blank final variable?

Yes, but only in constructor. For example:

```java
package finalInJava;

public class Example7 {

        final int speedlimit;

        Example7() {
                speedlimit = 70;
                System.out.println(speedlimit);
        }
```

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```java
        public static void main(String args[]) {
                new Example7();
        }
}
```

Static blank final variable

A static final variable that is not initialized at the time of declaration is known as static blank final variable. It can be initialized only in static block.

```java
package finalInJava;

public class Example8 {

        static final int data;
        static {
                data = 50;
        }

        public static void main(String args[]) {
                System.out.println(Example8.data);
        }
}
```

What is final parameter?

```java
package finalInJava;

public class Example9 {

        int cube(final int n) {
                n = n + 2;
                return n * n * n;
        }

        public static void main(String args[]) {
                Example9 b = new Example9();
                b.cube(5);
        }
}
```

Can we declare a constructor final?

Runtime Polymorphism in Java

Runtime polymorphism or **Dynamic Method Dispatch** is a process in which a call to an overridden method is resolved at runtime rather than compile-time.

In this process, an overridden method is called through the reference variable of a superclass. The determination of the method to be called is based on the object being referred to by the reference variable.

Example of Java Runtime Polymorphism

```java
package RuntimePolymorphism;

public class Example1 {

        void run() {
                System.out.println("running");
        }
}

package RuntimePolymorphism;

public class Example2 extends Example1{

        void run() {
                System.out.println("running safely with 60km");
        }

        public static void main(String args[]) {
                Example1 b = new Example2();// upcasting
                b.run();
        }
}

package RuntimePolymorphism;

public class Example3 {

        float getRateOfInterest() {
```

```java
            return 0;
        }
}

class SBI extends Example3 {
        float getRateOfInterest() {
                return 7.4f;
        }
}

class ICICI extends Example3 {
        float getRateOfInterest() {
                return 7.3f;
        }
}

class HDFC extends Example3 {
        float getRateOfInterest() {
                return 8.7f;
        }
}

class TestPolymorphism {
        public static void main(String args[]) {
                Example3 b;
                b = new SBI();
                System.out.println("SBI Rate of Interest: " + b.getRateOfInterest());
                b = new ICICI();
                System.out.println("ICICI Rate of Interest: " + b.getRateOfInterest());
                b = new HDFC();
                System.out.println("HDFC Rate of Interest: " + b.getRateOfInterest());
        }
}


package RuntimePolymorphism;

public class Animal {

        void eat() {
                System.out.println("eating...");
        }
}
```

```java
package RuntimePolymorphism;

public class Cat extends Animal{

    void eat() {
        System.out.println("eats rat...");
    }
}


package RuntimePolymorphism;

public class Dog extends Animal{

    void eat() {
        System.out.println("eats bread...");
    }

}


package RuntimePolymorphism;

public class Lion extends Animal{

    void eat() {
        System.out.println("eats meat...");
    }
}
```

Static Binding and Dynamic Binding

When type of the object is determined at compiled time(by the compiler), it is known as static binding.

If there is any private, final or static method in a class, there is static binding.

```java
package staticAndDynamicBinding;

public class Example1 {
    private void eat() {
        System.out.println("dog is eating...");
    }
```

```java
        public static void main(String args[]) {
                Example1 d1 = new Example1();
                d1.eat();
        }
}
```

Dynamic binding

When type of the object is determined at run-time, it is known as dynamic binding.

```java
package staticAndDynamicBinding;

public class Example3 extends Example2 {
        void eat() {
                System.out.println("dog is eating...");
        }

        public static void main(String args[]) {
                Example2 a = new Example3();
                a.eat();
        }

}
```

Java instanceof

The **java instanceof operator** is used to test whether the object is an instance of the specified type (class or subclass or interface).

```java
package instanceOfInJava;

public class Example1 {

        public static void main(String args[]) {
                Example1 s = new Example1();
                System.out.println(s instanceof Example1);
        }
}
```

```java
package instanceOfInJava;

public class Animal {
```

```java
}

package instanceOfInJava;

public class Dog extends Animal {

    public static void main(String args[]) {
        Dog d = new Dog();
        System.out.println(d instanceof Animal);
    }
}

package instanceOfInJava;

public class Example2 extends Example1 {

    public static void main(String[] args) {
        Example2 obj = new Example2();

        if (obj instanceof Example1) {
            System.out.println("Obj instanceof Example1");
        } else {
            System.out.println("Obj NOT instanceof Example1");
        }

        if (obj instanceof Example2) {
            System.out.println("Obj instanceof Example2");
        } else {
            System.out.println("Obj NOT instanceof Example2");
        }

        if (obj instanceof Object) {
            System.out.println("Obj instanceof Object");
        } else {
            System.out.println("Obj NOT instanceof Object");
        }

        Example1 obj1 = new Example1();

        if (obj1 instanceof Example1) {
            System.out.println("Obj instanceof Example1");
        } else {
            System.out.println("Obj NOT instanceof Example1");
```

```java
                }

                if (obj1 instanceof Example2) {
                        System.out.println("Obj instanceof Example2");
                } else {
                        System.out.println("Obj NOT instanceof Example2");
                }

                if (obj1 instanceof Object) {
                        System.out.println("Obj instanceof Object");
                } else {
                        System.out.println("Obj NOT instanceof Object");
                }
        }

}
```

Encapsulation in Java

Suppose you have an account in the bank. If your balance variable is declared as a public variable in the bank software, your account balance will be known as public, In this case, anyone can know your account balance. So, would you like it? Obviously No.

So, they declare balance variable as private for making your account safe, so that anyone cannot see your account balance. The person who has to see his account balance, he will have to access private members only through methods defined inside that class and this method will ask your account holder name or user Id, and password for authentication.

Thus, We can achieve security by utilizing the concept of data hiding. This is called Encapsulation.

Key point:

In Java, Encapsulation is one of the four principles of OOPs concepts and the other three are Abstraction, Inheritance, and Polymorphism.
How to achieve or implement Encapsulation in Java

We can achieve encapsulation in Java in the following ways.
1. Declaring the instance variable of the class as private. so that it cannot be accessed directly by anyone from outside the class.
2. Provide the public setter and getter methods in the class to set/modify the values of the variable/fields.

Advantages of Encapsulation in Java

There are following advantages of encapsulation in Java.
1. The encapsulated code is more flexible and easy to change with new requirements.
2. It prevents the other classes to access the private fields.
3. Encapsulation allows modifying implemented code without breaking others code who have implemented the code.
4. It keeps the data and codes safe from external inheritance. Thus, Encapsulation helps to achieve security.
5. It improves the maintainability of the application.
6. If you don't define the setter method in the class then the fields can be made read-only.
7. If you don't define the getter method in the class then the fields can be made write-only.

Disadvantages of Encapsulation in Java
The main disadvantage of the encapsulation in Java is it increases the length of the code and slow shutdown execution.


```java
package encapsulationInJava;

public class Example2 {

        private String name;

        private String age;

        public String getName() {
                return name;
        }

        public void setName(String name) {
                this.name = name;
        }

        public String getAge() {
                return age;
        }

        public void setAge(String age) {
                this.age = age;
        }

}
```

```java
package encapsulationInJava;

public class TestExample2 {

    public static void main(String[] args) {
        Example2 obj = new Example2();
        obj.setAge("10");
        obj.setName("Test");

        System.out.println("name="+obj.getName()+" age="+obj.getAge());
    }
}
```

While setting data to variables we can provide validation logic

```java
package encapsulationInJava;

public class Example3 {

    private int age;
    private String name;

    public int getAge() {
        return age;
    }

    public void setAge(int age) throws Exception {

        if (age < 10) {
            throw new Exception("age should not be less than 10");
        }
        this.age = age;
    }

    public String getName() {
        return name;
    }

    public void setName(String name) throws Exception {
        if (name == null || name == "") {
            throw new Exception("name should not be empty or null");

        }
        this.name = name;
```

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```
        }

}

package encapsulationInJava;

public class TestExample3 {

        public static void main(String[] args) throws Exception {
                Example3 obj = new Example3();
                obj.setAge(11);
                System.out.println(obj.getAge());

                obj.setAge(9);
                System.out.println(obj.getAge());
        }

}
```

It help us to provide read only access

```
package encapsulationInJava;

public class Example4 {

        private String schoolName = "ABC";

        private String studentName;

        public String getSchoolName() {
                return schoolName;
        }

        public String getStudentName() {
                return studentName;
        }

        public void setStudentName(String studentName) {
                this.studentName = studentName;
        }

        @Override
        public String toString() {
```

```java
            return "Example4 [schoolName=" + schoolName + ", studentName=" +
studentName + "]";
        }

}

package encapsulationInJava;

public class TestExample4 {

        public static void main(String[] args) {
                Example4 obj = new Example4();
                obj.setStudentName("Ram");

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

Let's understand how Encapsulation allows modifying implemented Java code without breaking others code who have implemented the code? Since data type of Id has been changed from String to Integer. So, I will only change in getter and setter method to avoid breaking of other codes.

```java
package encapsulationInJava;

public class Student {

        String id; // Here, No encapsulation is used. Since the field is not
                                // private.
}
```

```java
package encapsulationInJava;

public class EncapsulationTest1 {

        public static void main(String[][] args) {
                Student st = new Student();
                st.id = "5"; // As the field is not private. So, it can be accessed by
                                        // anyone from outside the class.
        }
}
```

Suppose in above program 3, anyone changes the data type of id from String to Integer like this:

package encapsulationInJava;

public class Student {

        int id; // Here, No encapsulation is used. Since the field is not
                                  // private.
}

package encapsulationInJava;

public class EncapsulationTest1 {

        public static void main(String[][] args) {
                Student st = **new** Student();
                st.id = "5";
        }
}

Now, what will happen? Whenever Id has been used then the compilation time error will be generated.

When you have encapsulation , this issue can be solved without breaking the implementation.

public class Student {

        Integer id;

        public String getId() {
                return String.*valueOf*(id);
        }

        public void setId(String id) {
                this.id = Integer.*parseInt*(id);
        }
}

What is Abstraction

Abstraction is a process of hiding the implementation details from the user. Only the functionality will be provided to the user. In Java, abstraction is achieved using abstract classes and interfaces.

Java Abstraction Example

To give an example of abstraction we will create one superclass called Employee and two subclasses – Contractor and FullTimeEmployee. Both subclasses have common properties to share, like the name of the employee and the the amount of money the person will be paid per hour. There is one major difference between contractors and full-time employees – the time they work for the company. Full-time employees work constantly 8 hours per day and the working time of contractors may vary.

```java
package abstractionInJava;

public abstract class Employee {
        private String name;
        private int paymentPerHour;

        public Employee(String name, int paymentPerHour) {
                this.name = name;
                this.paymentPerHour = paymentPerHour;
        }

        public abstract int calculateSalary();

        public String getName() {
                return name;
        }

        public void setName(String name) {
                this.name = name;
        }

        public int getPaymentPerHour() {
                return paymentPerHour;
        }

        public void setPaymentPerHour(int paymentPerHour) {
                this.paymentPerHour = paymentPerHour;
        }
```

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}

The Contractor class inherits all properties from its parent Employee but have to provide it's own implementation of calculateSalary() method. In this case we multiply the value of payment per hour with given working hours.

```java
package abstractionInJava;

public class Contractor extends Employee {

        private int workingHours;

        public Contractor(String name, int paymentPerHour, int workingHours) {
                super(name, paymentPerHour);
                this.workingHours = workingHours;
        }

        @Override
        public int calculateSalary() {
                return getPaymentPerHour() * workingHours;
        }
}
```

The FullTimeEmployee also has it's own implementation ofcalculateSalary()method. In this case we just multiply by constant 8 hours.

```java
package abstractionInJava;

public class FullTimeEmployee extends Employee {

        public FullTimeEmployee(String name, int paymentPerHour) {
                super(name, paymentPerHour);
        }

        @Override
        public int calculateSalary() {
                return getPaymentPerHour() * 8;
        }
}
```

String In Java

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String is a sequence of characters, for e.g. "Hello" is a string of 5 characters. In java, string is an immutable object which means it is constant and can cannot be changed once it has been created.

Creating a String

There are two ways to create a String in Java

1. String literal
2. Using new keyword

String literal

In java, Strings can be created like this: Assigning a String literal to a String instance:

String str1 = "Welcome";
String str2 = "Welcome";

if the object already exist in the memory it does not create a new Object rather it assigns the same old object to the new instance, that means even though we have two string instances above(str1 and str2) compiler only created on string object (having the value "Welcome") and assigned the same to both the instances. For example there are 10 string instances that have same value, it means that in memory there is only one object having the value and all the 10 string instances would be pointing to the same object.

Using New Keyword

String str1 = new String("Welcome");
String str2 = new String("Welcome");

In this case compiler would create two different object in memory having the same string.

Immutable String

Immutable String means , once String object is created it can't be changed or modified.

Example:

package stringInjava;

public class Example1 {

```
        public static void main(String args[]) {
                String s = "Bhanu";
                s.concat(" Java");
                System.out.println(s);
        }
}
```

Here output remains "Bhanu" , since String is immutable and new object is created in memory "BhanuJava"

String compare

There are three ways to compare string in java:

1. By equals() method
2. By = = operator
3. By compareTo() method

equals() method compares the original content of the string
The = = operator compares references not values.

The String compareTo() method compares values lexicographically and returns an integer value that describes if first string is less than, equal to or greater than second string.

Suppose s1 and s2 are two string variables. If:

o **s1 == s2** :0
o **s1 > s2**   :positive value
o **s1 < s2**   :negative value

```
package stringInjava;

public class Example2 {

        public static void main(String[] args) {

                String s1 = "Bhanu";
                String s2 = "Bhanu";
                String s3 = new String("Bhanu");
```

```java
        String s4 = "Test";
        System.out.println(s1.equals(s2));// true
        System.out.println(s1.equals(s3));// true
        System.out.println(s1.equals(s4));// false

        s1 = "Bhanu";
        s2 = "BHANU";

        System.out.println(s1.equals(s2));// false
        System.out.println(s1.equalsIgnoreCase(s2));// true

        s2 = "Bhanu";
        s3 = new String("Bhanu");
        System.out.println(s1 == s2);// true (because both refer to same instance)
        System.out.println(s1 == s3);// false(because s3 refers to instance created in
nonpool)


        s1 = "Bhanu";
        s2 = "Bhanu";
        s3 = "Bist1";
        System.out.println(s1.compareTo(s2));// 0
        System.out.println(s1.compareTo(s3));// -1(because s1>s3)
        System.out.println(s3.compareTo(s1));// 1(because s3 < s1 )
    }

}
```

Concatenation

   I.   By + (string concatenation) operator
  II.   By concat() method


```java
package stringInjava;

public class Example3 {

    public static void main(String[] args) {
        String s = 90 + 30 + "Bhanu" + 50 + 50;
        System.out.println(s);

        String s1 = "Bhanu ";
```

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```
            String s2 = "Pratap";
            String s3 = s1.concat(s2);
            System.out.println(s3);
        }

    }
```

Substring

You can get substring from the given string object by one of the two methods:

1. **public String substring(int startIndex):** This method returns new String object containing the substring of the given string from specified startIndex (inclusive).

2. **public String substring(int startIndex, int endIndex):** This method returns new String object containing the substring of the given string from specified startIndex to endIndex.

In case of string:

- o **startIndex:** inclusive
- o **endIndex:** exclusive

```
package stringInjava;

public class Example4 {

        public static void main(String[] args) {
                String s = "Bhanupratap";
                System.out.println(s.substring(6));
                System.out.println(s.substring(0, 6));
        }
}
```

charAt()

```
package stringInjava;

public class Example5 {

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

```java
        String name = "bhanupratap";
        char ch = name.charAt(4);
        System.out.println(ch);

        name.charAt(20);
    }
}
```

contains()

```java
package stringInjava;

public class Example7 {

    public static void main(String[] args) {
        String name = "Hello java program";
        System.out.println(name.contains("java program"));
        System.out.println(name.contains("am"));
        System.out.println(name.contains("hello"));
    }
}
```

```java
package stringInjava;

public class Example8 {

    public static void main(String[] args) {
        String str = "if you want to move in automation learn java";
        if (str.contains("learn java")) {
            System.out.println("I am in");
        } else
            System.out.println("Result not found");
    }
}
```

endsWith()

```java
package stringInjava;

public class Example9 {

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

```java
        String s1 = "bhanu test";
        System.out.println(s1.endsWith("t"));
        System.out.println(s1.endsWith("test1"));

        String str = "Welcome to youtube channel";
        if (str.endsWith("channel")) {
            System.out.println("Welcome to youtube channel");
        } else
            System.out.println("It does not end with channel");
    }
}
```

equals()

```java
package stringInjava;

public class Example10 {

    public static void main(String[] args) {
        String s1 = "java";
        String s2 = "c";
        String s3 = "java";
        String s4 = "python";
        System.out.println(s1.equals(s2));
        System.out.println(s1.equals(s3));
        System.out.println(s1.equals(s4));
    }

}
```

equalsIgnoreCase()

```java
package stringInjava;

public class Example11 {

    public static void main(String[] args) {
        String s1 = "bhanu";
        String s2 = "bhanu";
        String s3 = "BHANU";
        String s4 = "TEST";
        System.out.println(s1.equalsIgnoreCase(s2));
```

```java
        System.out.println(s1.equalsIgnoreCase(s3));
        System.out.println(s1.equalsIgnoreCase(s4));
    }
}
```

format()

The **java string format()** method returns the formatted string by given locale, format and arguments.

Throws

NullPointerException : if format is null.

IllegalFormatException : if format is illegal or incompatible.

```java
package stringInjava;

public class Example12 {

    public static void main(String[] args) {
        String name = "bhanu";
        String sf1 = String.format("name is %s", name);
        String sf2 = String.format("value is %f", 32.33434);
        String sf3 = String.format("value is %.12f", 32.33434);
        System.out.println(sf1);
        System.out.println(sf2);
        System.out.println(sf3);
    }
}
```

```java
package stringInjava;

public class Example12 {

    public static void main(String[] args) {
        String name = "bhanu";
        String sf1 = String.format("name is %s", name);
        String sf2 = String.format("value is %f", 32.33434);
        String sf3 = String.format("value is %.12f", 32.33434);
        System.out.println(sf1);
```

```java
        System.out.println(sf2);
        System.out.println(sf3);

        String str1 = String.format("%d", 104); // Integer value
        String str2 = String.format("%s", "Bhanu Pratap"); // String value
        String str3 = String.format("%f", 104.00); // Float value
        String str4 = String.format("%x", 104); // Hexadecimal value
        String str5 = String.format("%c", 'a'); // Char value
        System.out.println(str1);
        System.out.println(str2);
        System.out.println(str3);
        System.out.println(str4);
        System.out.println(str5);
```

example where we are setting width and padding for an integer value.

```java
        str1 = String.format("%d", 101);
        str2 = String.format("|%10d|", 101);
        str3 = String.format("|%-10d|", 101);
        str4 = String.format("|% d|", 101);
        str5 = String.format("|%010d|", 101);
        System.out.println(str1);
        System.out.println(str2);
        System.out.println(str3);
        System.out.println(str4);
        System.out.println(str5);
    }
}
```

getBytes()

Method returns the byte array of the string

```java
package stringInjava;

public class Example13 {

    public static void main(String[] args) {
        String s1 = "ABCDEFG";
        byte[] barr = s1.getBytes();
        for (int i = 0; i < barr.length; i++) {
            System.out.println(barr[i]);
        }
```

```
        }
}
```

getChars()

Method copies the content of this string into specified char array

public void getChars(**int** srcBeginIndex, **int** srcEndIndex, **char**[] destination, **int** dstBeginIndex)

Throws

It throws StringIndexOutOfBoundsException if beginIndex is greater than endIndex.

package stringInjava;

public class Example14 {

```
        public static void main(String[] args) {
                String str = new String("java is programming language");
                char[] ch = new char[10];
                try {
                        str.getChars(5, 15, ch, 0);
                        System.out.println(ch);
                } catch (Exception ex) {
                        System.out.println(ex);
                }
        }
}
```

java.lang.ArrayIndexOutOfBoundsException

package stringInjava;

public class Example15 {

```
        public static void main(String[] args) {
                String str = new String("java is programming language");
                char[] ch = new char[10];
                try {
                        str.getChars(5, 20, ch, 0);
                        System.out.println(ch);
                } catch (Exception ex) {
```

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

indexOf()

Method	Description
int indexOf(int ch)	returns index position for the given char value
int indexOf(int ch, int fromIndex)	returns index position for the given char value and from index
int indexOf(String substring)	returns index position for the given substring
int indexOf(String substring, int fromIndex)	returns index position for the given substring and from index

```
package stringInjava;

public class Example16 {

        public static void main(String[] args) {
                String s1 = "hello java program";
                int index1 = s1.indexOf("ja");
                int index2 = s1.indexOf("java");
                System.out.println(index1);
                System.out.println(index2);

                int index3 = s1.indexOf("ro", 4);
                System.out.println(index3);

                int index4 = s1.indexOf('a');
                System.out.println(index4);
        }
}
```

intern()

```
package stringInjava;

public class Example17 {

        public static void main(String[] args) {
                String s1 = new String("java");
```

```java
            String s2 = "java";
            String s3 = s1.intern();
            System.out.println(s1 == s2);
            System.out.println(s2 == s3);
        }
}

package stringInjava;

public class Example18 {

        public static void main(String[] args) {
                String s1 = "Java";
                String s2 = s1.intern();
                String s3 = new String("Java");
                String s4 = s3.intern();
                System.out.println(s1 == s2);
                System.out.println(s1 == s3);
                System.out.println(s1 == s4);
                System.out.println(s2 == s3);
                System.out.println(s2 == s4);
                System.out.println(s3 == s4);
        }
}
```

isEmpty()

```java
package stringInjava;

public class Example19 {

        public static void main(String[] args) {
                String s1 = "";
                String s2 = "javatest";

                System.out.println(s1.isEmpty());
                System.out.println(s2.isEmpty());
        }
}
```

join()

```java
package stringInjava;
```

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```
public class Example20 {

        public static void main(String[] args) {
                String s1 = String.join("-", "hello", "java", "program");
                System.out.println(s1);
        }
}


package stringInjava;

public class Example21 {

        public static void main(String[] args) {
                String d = String.join("/", "20", "04", "2016");
                System.out.print(d);
                String t = String.join(":", "11", "13", "10");
                System.out.println(t);
        }

}
```

lastIndexOf()

Method	Description
int lastIndexOf(int ch)	returns last index position for the given char value
int lastIndexOf(int ch, int fromIndex)	returns last index position for the given char value and from index
int lastIndexOf(String substring)	returns last index position for the given substring
int lastIndexOf(String substring, int fromIndex)	returns last index position for the given substring and from index

```
package stringInjava;

public class Example22 {

        public static void main(String[] args) {
                String s1 = "this is java index";
                int index = s1.lastIndexOf('s');
```

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```java
            System.out.println(index);

            s1.lastIndexOf('s', 5);
            System.out.println(index);

            s1.lastIndexOf("of");
            System.out.println(index);
        }
}
```

length()

```java
package stringInjava;

public class Example23 {

        public static void main(String args[]) {
                String s1 = "bhanujava";
                String s2 = "test";
                System.out.println("string length is: " + s1.length());
                System.out.println("string length is: " + s2.length());
        }

}
```

replace()

```java
package stringInjava;

public class Example24 {

        public static void main(String args[]) {
                String s1 = "hello java test";
                String replaceString = s1.replace('a', 'e');
                System.out.println(replaceString);
        }
}
```

split()

```java
package stringInjava;
```

```java
public class Example25 {

        public static void main(String args[]) {
                String s1 = "hello java test";
                String[] words = s1.split("\\s");
                for (String w : words) {
                        System.out.println(w);
                }

                s1 = "hello:java:test";
                words = s1.split(":");
                for (String w : words) {
                        System.out.println(w);
                }
        }
}
```

startsWith()

```java
package stringInjava;

public class Example26 {

        public static void main(String[] args) {
                String s1 = "hello java test program";
                System.out.println(s1.startsWith("hel"));
                System.out.println(s1.startsWith("hello java"));

                System.out.println(s1.startsWith("a",7));

                System.out.println(s1.startsWith("a",40));
        }
}
```

substring()

Parameters

startIndex : starting index is inclusive

endIndex : ending index is exclusive

```java
package stringInjava;

public class Example27 {

    public static void main(String[] args) {
        String s1 = "hellojavatest";
        String substr = s1.substring(0);
        System.out.println(substr);
        String substr2 = s1.substring(5, 10);
        System.out.println(substr2);

        // java.lang.StringIndexOutOfBoundsException:
        String substr3 = s1.substring(5, 15);
    }
}
```

toCharArray()

```java
package stringInjava;

public class Example28 {

    public static void main(String[] args) {
        String s1 = "hello java test";
        char[] ch = s1.toCharArray();
        int len = ch.length;
        System.out.println("Char Array length: " + len);
        System.out.println("Char Array elements: ");
        for (int i = 0; i < len; i++) {
            System.out.println(ch[i]);
        }
    }
}
```

toLowerCase()

toUpperCase()

```java
package stringInjava;

public class Example29 {

    public static void main(String[] args) {
        String s = "hello java";

        System.out.println(s.toUpperCase());

        String s1 = "HELLO";

        System.out.println(s1.toLowerCase());
    }
}
```

trim()

```java
package stringInjava;

public class Example30 {

    public static void main(String[] args) {
        String s1 = " Hello Java ";

        System.out.println("123"+s1.trim()+"12");


        System.out.println("123"+s1+"12");
    }
}
```

valueOf()

The **java string valueOf()** method converts different types of values into string.
- **public static** String valueOf(**boolean** b)
- **public static** String valueOf(**char** c)
- **public static** String valueOf(**char**[] c)
- **public static** String valueOf(**int** i)
- **public static** String valueOf(**long** l)

- **public static** String valueOf(**float** f)
- **public static** String valueOf(**double** d)
- **public static** String valueOf(Object o)

```java
package stringInjava;

public class Example31 {

    public static void main(String[] args) {
        float f = 10.05f;
        double d = 10.02;
        String s1 = String.valueOf(f);
        String s2 = String.valueOf(d);
        System.out.println(s1);
        System.out.println(s2);

        char ch1 = 'A';
        char ch2 = 'B';
        s1 = String.valueOf(ch1);
        s2 = String.valueOf(ch2);
        System.out.println(s1);
        System.out.println(s2);

        int value = 30;
        s1 = String.valueOf(value);
        System.out.println(s1);
    }

}
```

Java String Buffer class

Java StringBuffer class is used to create mutable (modifiable) string.

Constructor	Description
StringBuffer()	creates an empty string buffer with the initial capacity of 16.
StringBuffer(String str)	creates a string buffer with the specified string.
StringBuffer(int capacity)	creates an empty string buffer with the specified capacity as length.

Type	Method	Description
public synchronized StringBuffer	append(String s)	is used to append the specified string with this string. The append() method is overloaded like append(char), append(boolean), append(int), append(float), append(double) etc.
public synchronized StringBuffer	insert(int offset, String s)	is used to insert the specified string with this string at the specified position. The insert() method is overloaded like insert(int, char), insert(int, boolean), insert(int, int), insert(int, float), insert(int, double) etc.
public synchronized StringBuffer	replace(int startIndex, int endIndex, String str)	is used to replace the string from specified startIndex and endIndex.
public synchronized StringBuffer	delete(int startIndex, int endIndex)	is used to delete the string from specified startIndex and endIndex.
public synchronized StringBuffer	reverse()	is used to reverse the string.
public int	capacity()	is used to return the current capacity.
public void	ensureCapacity(int minimumCapacity)	is used to ensure the capacity at least equal to the given minimum.
public char	charAt(int index)	is used to return the character at the specified position.
public int	length()	is used to return the length of the string i.e. total number of characters.
public String	substring(int beginIndex)	is used to return the substring from the specified beginIndex.
public String	substring(int beginIndex, int endIndex)	is used to return the substring from the specified beginIndex and endIndex.

```
package stringBuffer;

public class Example1 {

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

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```java
        StringBuffer sb = new StringBuffer("hello ");
        sb.append("Java");
        System.out.println(sb);

        // insert() method

        StringBuffer sb1 = new StringBuffer("Hello ");
        sb1.insert(1, "Java");
        System.out.println(sb1);

        // replace() method
        StringBuffer sb2 = new StringBuffer("Hello");
        sb2.replace(1, 3, "Java");
        System.out.println(sb2);

        // delete() method
        StringBuffer sb3 = new StringBuffer("Hello");
        sb3.delete(1, 3);
        System.out.println(sb3);

        // capacity() method

        StringBuffer sb4 = new StringBuffer();
        System.out.println(sb4.capacity());// default 16
        sb4.append("Hello");
        System.out.println(sb4.capacity());// now 16
        sb4.append("java is my favourite language");
        System.out.println(sb4.capacity());// now (16*2)+2=34 i.e //
(oldcapacity*2)+2
    }

}


package stringBuffer;

public class Example2 {

    public static void main(String args[]) {
        StringBuffer sb = new StringBuffer();
        System.out.println(sb.capacity());// default 16
        sb.append("Hello");
        System.out.println(sb.capacity());// now 16
        sb.append("java is programming language");
```

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```
            System.out.println(sb.capacity());// now (16*2)+2=34 i.e
                                                                    //
(oldcapacity*2)+2
            sb.ensureCapacity(10);// now no change
            System.out.println(sb.capacity());// now 34
            sb.ensureCapacity(50);// now (34*2)+2
            System.out.println(sb.capacity());// now 70
        }
}
```

Java StringBuilder class

Java StringBuilder class is used to create mutable (modifiable) string. The Java StringBuilder class is same as StringBuffer class except that it is non-synchronized.

Constructor	Description
StringBuilder()	creates an empty string Builder with the initial capacity of 16.
StringBuilder(String str)	creates a string Builder with the specified string.
StringBuilder(int length)	creates an empty string Builder with the specified capacity as length.

Performance Test of String and StringBuffer

```java
package stringBuffer;

public class Example3 {

    public static String concatString() {
        String t = "Hello";
        for (int i = 0; i < 10000; i++) {
            t = t + "Java";
        }
        return t;
    }

    public static String concatStringBuffer() {
        StringBuffer sb = new StringBuffer("Hello");
        for (int i = 0; i < 10000; i++) {
            sb.append("Java");
        }
        return sb.toString();
```

```java
        }

        public static void main(String[] args) {
                long startTime = System.currentTimeMillis();
                Example3.concatString();
                long endTime = System.currentTimeMillis();
                System.out.println("Time Take my string=" + (endTime - startTime));

                long startTime1 = System.currentTimeMillis();
                Example3.concatStringBuffer();
                long endTime1 = System.currentTimeMillis();

                System.out.println("Time Take my string=" + (endTime1 - startTime1));
        }

}
```
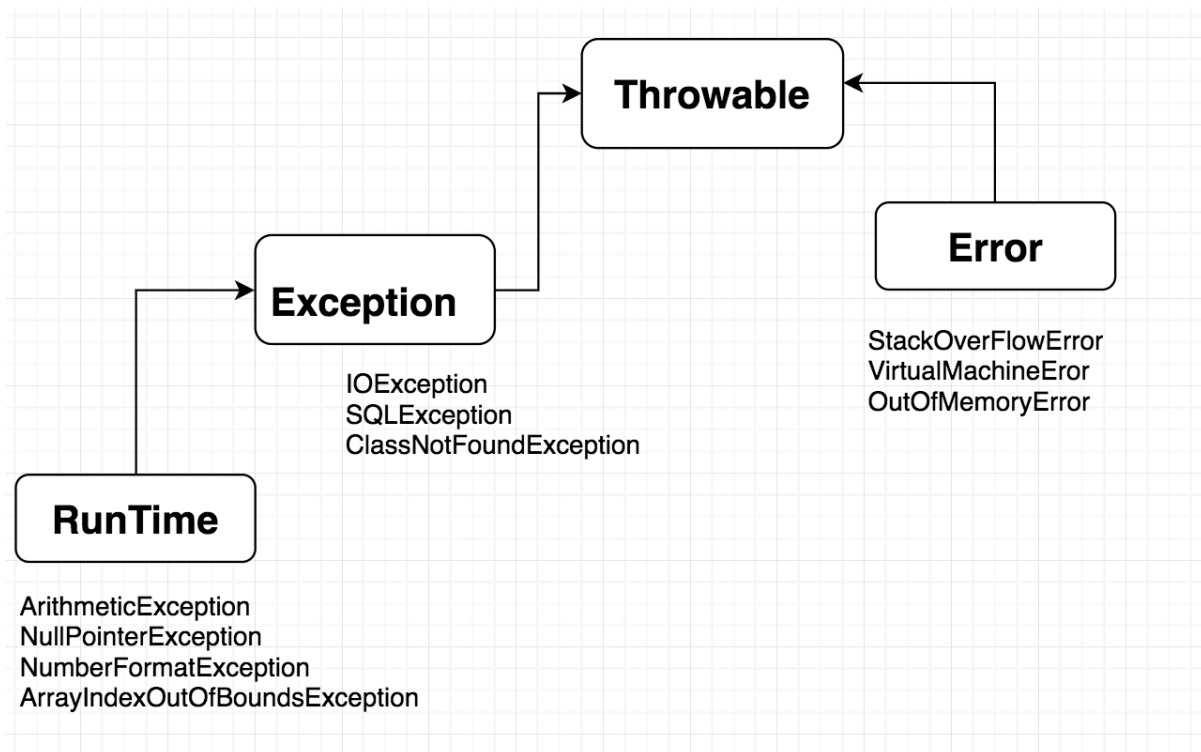
Exception in Java

Exceptions are events that occur during the execution of programs that disrupt the normal flow of instructions (e.g. divide by zero, array access out of bound, etc.). In **Java**, an **exception** is an object that wraps an error event that occurred within a method and contains: Information about the error including its type.

Throwable

Exception
IOException
SQLException
ClassNotFoundException

Error
StackOverFlowError
VirtualMachineEror
OutOfMemoryError

RunTime
ArithmeticException
NullPointerException
NumberFormatException
ArrayIndexOutOfBoundsException

How JVM handle an Exception?

Default Exception Handling : Whenever inside a method, if an exception has occurred, the method creates an Object known as Exception Object and hands it off to the run-time system(JVM). The exception object contains name and description of the exception, and current state of the program where exception has occurred. Creating the Exception Object and handling it to the run-time system is called throwing an Exception.There might be the list of the methods that had been called to get to the method where exception was occurred. This ordered list of the methods is called **Call Stack**.Now the following procedure will happen.

- The run-time system searches the call stack to find the method that contains block of code that can handle the occurred exception. The block of the code is called **Exception handler**.
- The run-time system starts searching from the method in which exception occurred, proceeds through call stack in the reverse order in which methods were called.
- If it finds appropriate handler then it passes the occurred exception to it. Appropriate handler means the type of the exception object thrown matches the type of the exception object it can handle.
- If run-time system searches all the methods on call stack and couldn't have found the appropriate handler then run-time system handover the Exception Object to **default exception handler** , which is part of run-time system. This handler prints the exception information in the following format and terminates program **abnormally**.

Code without and without exception handling

```java
package exception;

public class Example1 {

    public void test1() {
        int i = 90 / 0;
        System.out.println("execution completed");
    }

    public void test2() {
        try {
            int i = 90 / 0;
        } catch (Exception e) {
            System.out.println("exception occured");
        }
        System.out.println("execution completed");
    }

    public static void main(String[] args) {
        Example1 obj = new Example1();
        //obj.test1();
        obj.test2();
    }

}
```

Types of Exception

Built-in exceptions are the exceptions which are available in Java libraries. These exceptions are suitable to explain certain error situations. Below is the list of important built-in exceptions in Java.

1. **Arithmetic Exception**
   It is thrown when an exceptional condition has occurred in an arithmetic operation.
2. **ArrayIndexOutOfBoundException**
   It is thrown to indicate that an array has been accessed with an illegal index. The index is either negative or greater than or equal to the size of the array.
3. **ClassNotFoundException**
   This Exception is raised when we try to access a class whose definition is not found
4. **FileNotFoundException**
   This Exception is raised when a file is not accessible or does not open.

5. **IOException**
   It is thrown when an input-output operation failed or interrupted
6. **InterruptedException**
   It is thrown when a thread is waiting , sleeping , or doing some processing , and it is interrupted.
7. **NoSuchFieldException**
   It is thrown when a class does not contain the field (or variable) specified
8. **NoSuchMethodException**
   It is thrown when accessing a method which is not found.
9. **NullPointerException**
   This exception is raised when referring to the members of a null object. Null represents nothing
10. **NumberFormatException**
    This exception is raised when a method could not convert a string into a numeric format.
11. **RuntimeException**
    This represents any exception which occurs during runtime.
12. **StringIndexOutOfBoundsException**
    It is thrown by String class methods to indicate that an index is either negative than the size of the string

```
Exception in thread "main" java.lang.ArithmeticException: / by zero
        at exception.Example2.main(Example2.java:6)
```

```java
package exception;

public class Example2 {

        public static void main(String[] args) {
                int i = 90 / 0;
        }

}
```

```
Exception in thread "main" java.lang.ArrayIndexOutOfBoundsException:
8
        at exception.Example3.main(Example3.java:7)
```

```java
package exception;

public class Example3 {
```

```java
        public static void main(String[] args) {
                int a[] = { 10, 20, 30 };
                System.out.println(a[8]);
        }
}
```

Exception in thread "main" java.lang.NullPointerException
        at exception.Example4.main(Example4.java:7)

```java
package exception;

public class Example4 {

        public static void main(String[] args) {
                String s1 = null;
                System.out.println(s1.toString());
        }
}
```

Checked Exception Example

Exception in thread "main" java.lang.ClassNotFoundException: Test12
        at java.net.URLClassLoader.findClass(URLClassLoader.java:381)
        at java.lang.ClassLoader.loadClass(ClassLoader.java:424)

```java
package exception;

public class Example5 {

        public static void main(String[] args) throws ClassNotFoundException {
                Class.forName("Test12");
        }
}
```

IOException is checked exception

Exception in thread "main" java.io.FileNotFoundException: (No such
file or directory)
        at java.io.FileInputStream.open0(Native Method)

```java
package exception;
```

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```java
import java.io.BufferedReader;
import java.io.File;
import java.io.FileReader;
import java.io.IOException;

public class Example6 {

        public static void main(String[] args) throws IOException {
                BufferedReader rd = new BufferedReader(new FileReader(new File("")));
                rd.readLine();
        }
}
```

How Programmer handles an exception?

Customized Exception Handling : Java exception handling is managed via five keywords: **try**, **catch**, **throw, throws, and finally**. Briefly, here is how they work. Program statements that you think can raise exceptions are contained within a try block. If an exception occurs within the try block, it is thrown. Your code can catch this exception (using catch block) and handle it in some rational manner. System-generated exceptions are automatically thrown by the Java run-time system. To manually throw an exception, use the keyword throw. Any exception that is thrown out of a method must be specified as such by a throws clause. Any code that absolutely must be executed after a try block completes is put in a finally block.

Try, Catch and Finally syntax

```java
        try {
                // block of code to monitor for errors
                // the code you think can raise an exception
                }
                catch (ExceptionType1 ex) {
                // exception handler for ExceptionType1
                }
                catch (ExceptionType2 ex) {
                // exception handler for ExceptionType2
                }
                // optional
                finally {
                // block of code to be executed after try block ends
                }
```

Points to remember :

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- In a method, there can be more than one statements that might throw exception, So put all these statements within its own **try** block and provide separate exception handler within own **catch** block for each of them.
- If an exception occurs within the **try** block, that exception is handled by the exception handler associated with it. To associate exception handler, we must put **catch** block after it. There can be more than one exception handlers. Each **catch** block is a exception handler that handles the exception of the type indicated by its argument. The argument, Exception Type declares the type of the exception that it can handle and must be the name of the class that inherits from **Throwable** class.
- For each try block there can be zero or more catch blocks, but **only one** finally block.
- The finally block is optional. It always gets executed whether an exception occurred in try block or not . If exception occurs, then it will be executed after **try and catch blocks.** And if exception does not occur then it will be executed after the **try** block. The finally block in java is used to put important codes such as clean up code e.g. closing the file or closing the connection.

```java
package exception;

public class Example7 {

	public void handelException() {
		try {
			int i = 90 / 0;
		} catch (Exception e) {
			System.out.println("exception handeled");
		}
		System.out.println("code execution completed");
	}

	public void donotHandelException() {
		int i = 90 / 0;
		System.out.println("code execution completed");
	}

	public static void main(String[] args) {
		Example7 obj = new Example7();
		obj.handelException();
		obj.donotHandelException();
	}
}
```

Handel Exception only for NumberFormatException

```java
package exception;
```

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```java
public class Example8 {

    public void handelException() {
        try {
            int i = 90 / 1;
            int a[] = { 20 };
            int k = a[2];
        } catch (ArithmeticException e) {
            System.out.println("exception handeled");
        }
        System.out.println("code execution completed");
    }

    public static void main(String[] args) {
        Example8 obj = new Example8();
        obj.handelException();
    }
}
```

Handel Exception for NumberFormatException and ArrayIndexOutOfBoundsException

```java
package exception;

public class Example9 {

    public void handelException() {
        try {
            int i = 90 / 1;
            int a[] = { 20 };
            int k = a[2];
        } catch (ArithmeticException e) {
            System.out.println("ArithmeticException handeled");
        } catch (ArrayIndexOutOfBoundsException e) {
            System.out.println("ArrayIndexOutOfBoundsException handeled");
        }
        System.out.println("code execution completed");
    }

    public static void main(String[] args) {
        Example9 obj = new Example9();
        obj.handelException();
    }
```

}

Handel Individual and all type of exception

```java
package exception;

public class Example10 {

    public void handelException() {
        try {
            int i = 90 / 1;
            int a[] = { 20 };
            int k = a[0];

            String s1 = null;
            System.out.println(s1.length());
        } catch (ArithmeticException e) {
            System.out.println("ArithmeticException handeled");
        } catch (ArrayIndexOutOfBoundsException e) {
            System.out.println("ArrayIndexOutOfBoundsException handeled");
        } catch (Exception e) {
            System.out.println("Exception=" + e.getClass().getName());
        }
        System.out.println("code execution completed");
    }

    public static void main(String[] args) {
        Example10 obj = new Example10();
        obj.handelException();
    }
}
```

Nested Try Catch

```java
package exception;

public class Example11 {

    public void test1() {
        int i = 90 / 1;
    }

    public void test2() {
```

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```java
            int a[] = { 20 };
            int k = a[1];
        }

        public void test3() {
            try {
                test1();
                System.out.println("No exception is test1() method");
                try {
                    test2();
                    System.out.println("No exception is test2() method");
                } catch (ArrayIndexOutOfBoundsException e) {
                    System.out.println("ArrayIndexOutOfBoundsException
handeled");
                }
            } catch (ArithmeticException e) {
                System.out.println("ArithmeticException handeled");
            }
        }

        public static void main(String[] args) {
            Example11 obj = new Example11();
            obj.test3();
        }

}

package exception;

public class Example12 {

        public static void main(String args[]) {
            try {
                try {
                    try {
                        int arr[] = { 1, 2, 3, 4 };
                        System.out.println(arr[10]);
                    } catch (ArithmeticException e) {
                        System.out.print("Arithmetic Exception");
                        System.out.println(" handled in Third try-block");
                    }
                } catch (ArithmeticException e) {
                    System.out.print("Arithmetic Exception");
                    System.out.println(" handled in Second try-block");
```

```java
            }
        } catch (ArithmeticException e3) {
            System.out.print("Arithmetic Exception");
            System.out.println(" handled in main try-block");
        } catch (ArrayIndexOutOfBoundsException e4) {
            System.out.print("ArrayIndexOutOfBoundsException");
            System.out.println(" handled in main try-block");
        } catch (Exception e5) {
            System.out.print("Exception");
            System.out.println(" handled in main try-block");
        }
    }
}

package exception;

public class Example13 {

    public static void main(String args[]) {
        // Parent try block
        try {
            // Child try block1
            try {
                System.out.println("Inside block1");
                int b = 40 / 0;
                System.out.println(b);
            } catch (ArithmeticException e) {
                System.out.println("Exception in Child try block1");
            }
            // Child try block2
            try {
                System.out.println("Inside block2");
                int b = 40 / 0;
                System.out.println(b);
            } catch (ArrayIndexOutOfBoundsException e) {
                System.out.println("Exception in Child try block2");
            }
            System.out.println("Just other statement");
        } catch (ArithmeticException e) {
            System.out.println("Arithmetic Exception");
            System.out.println("Inside parent try catch block");
        } catch (ArrayIndexOutOfBoundsException e) {
            System.out.println("ArrayIndexOutOfBoundsException");
            System.out.println("Inside parent try catch block");
```

```
        } catch (Exception e5) {
                System.out.println("Exception");
                System.out.println("Inside parent try catch block");
        }
        System.out.println("Hello java");
    }
}
```

A **finally block** contains all the crucial statements that must be executed whether exception occurs or not. The statements present in this block will always execute regardless of whether exception occurs in try block or not such as closing a connection, stream etc.

```
package exception;

public class Example14 {

    public static void main(String[] args) {
        try {
                int num = 9 / 0;
                System.out.println(num);
        } catch (ArithmeticException e) {
                System.out.println("Number should not be divided by zero");
        }
        /*
         * Finally block will always execute even if there is no exception in
         * try block
         */
        finally {
                System.out.println("This is finally block");
        }
        System.out.println("Out of try-catch-finally");
    }
}
```

Finally will get executed even if there is exception in program and it is not handled.

```
package exception;

public class Example15 {

    public static void main(String[] args) {
        try {
                int num = 9 / 0;
```

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```java
                System.out.println(num);
        } catch (NumberFormatException e) {
                System.out.println("Number should not be divided by zero");
        }
        finally {
                System.out.println("This is finally block");
        }
        System.out.println("Out of try-catch-finally");
        }
}



package exception;

public class Example16 {

        public static void main(String[] args) {
                try {
                        int num = 9 / 0;
                        System.out.println(num);
                } catch (ArithmeticException e) {
                        System.out.println("Number should not be divided by zero");
                } finally {
                        int num = 9 / 0;
                        System.out.println(num);
                        System.out.println("This is finally block");
                }
        }
}



package exception;

public class Example17 {

        public static void main(String[] args) {
                try {
                        int num = 9 / 1;
                        System.out.println(num);
                        return;
                } catch (ArithmeticException e) {
                        System.out.println("Number should not be divided by zero");
                } finally {
                        System.out.println("This is finally block");
```

```
            }
        }
}
```

throw exception in java

We can define our own set of conditions or rules and throw an exception explicitly using throw keyword. For example, we can throw ArithmeticException when we divide number by 5, or any other numbers, what we need to do is just set the condition and throw any exception using throw keyword. Throw keyword can also be used for throwing custom exceptions,

```java
package exception;

public class Example18 {

        static void checkEligibiltyProcess(int age, int weight) {
                if (age < 10 && weight < 30) {
                        throw new ArithmeticException("Student is not eligible for
registration");
                } else {
                        System.out.println("Student is eligible for registration");
                }
        }

        public static void main(String args[]) {
                System.out.println("Welcome to the Admission process");
                checkEligibiltyProcess(10, 39);
                System.out.println("Have a good day");

                checkEligibiltyProcess(9, 25);
        }
}
```

```
Welcome to the Admission process
Student is eligible for registrationException in thread "main"
Have a good day
java.lang.ArithmeticException: Student is not eligible for
registration
        at
exception.Example18.checkEligibiltyProcess(Example18.java:7)
        at exception.Example18.main(Example18.java:18)
```

```java
package exception;

public class Example19 {

	static void checkEligibiltyProcess(int age) {
		if (age < 18) {
			throw new ArithmeticException("Not Eligible for voting");
		} else {
			System.out.println("Eligible for voting");
		}
	}

	public static void main(String[] args) {
		Example19.checkEligibiltyProcess(20);
	}

}
```

throws Keyword

Any method that is capable of causing exceptions must list all the exceptions possible during its execution, so that anyone calling that method gets a prior knowledge about which exceptions are to be handled. A method can do so by using the **throws** keyword.

```java
package exception;

public class Example20 {

	static void check() throws ArithmeticException {
		System.out.println("Inside check function");
		throw new ArithmeticException("demo");
	}

	public static void main(String args[]) {
		try {
			check();
		} catch (ArithmeticException e) {
			System.out.println("caught" + e);
		}
	}

}
```

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```java
package exception;

import java.io.IOException;

public class Example21 {

    void test() throws IOException {
        throw new IOException("device error");// checked exception
    }

    void tset2() throws IOException {
        test();
    }

    void tset1() {
        try {
            tset2();
        } catch (Exception e) {
            System.out.println("exception handled");
        }
    }

    public static void main(String args[]) {
        Example21 obj = new Example21();
        obj.tset1();
        System.out.println("normal flow...");
    }
}
```

```java
package exception;

public class Example22 {

    void test1() throws ArithmeticException {
        throw new ArithmeticException("Calculation error");
    }

    void test2() throws ArithmeticException {
        test1();
    }

    void test3() {
        try {
```

```java
                test2();
        } catch (ArithmeticException e) {
                System.out.println("ArithmeticException handled");
        }
    }

    public static void main(String args[]) {
        Example22 obj = new Example22();
        obj.test3();
        System.out.println("End Of Program");
    }
}

package exception;

public class Example23 {

    void method() throws ArithmeticException {
        throw new ArithmeticException("ArithmeticException Occurred");
    }
}

package exception;

class Example24 {
    public static void main(String args[]) throws ArithmeticException {
        Example23 obj = new Example23();
        obj.method();

        System.out.println("End Of Program");
    }
}
```

Throw exception in catch block

```java
package exception;

public class Example25 {

    static void fun() {
        try {
            throw new NullPointerException("demo");
        } catch (NullPointerException e) {
            System.out.println("Caught inside fun().");
```

```java
            throw e;
        }
    }

    public static void main(String args[]) {
        try {
            fun();
        } catch (NullPointerException e) {
            System.out.println("Caught in main.");
        }
    }
}
```

Important points to remember about throws keyword:
- throws keyword is required only for checked exception and usage of throws keyword for unchecked exception is meaningless.
- throws keyword is required only to convince compiler and usage of throws keyword does not prevent abnormal termination of program.
- By the help of throws keyword we can provide information to the caller of the method about the exception.

Custom Exception

```java
package customException;

import java.io.Serializable;

public class DataException extends Exception implements Serializable {

    /**
     *
     */
    private static final long serialVersionUID = 1L;

    DataException(String msg, Throwable t) {
        super(msg, t);
    }

    DataException(String msg) {
        super(msg);
    }

}
```

```java
package customException;

public class TestDataException {

    public static void test1(int a) throws DataException {
        if (a < 10) {
            throw new DataException("data is not valid");
        }
    }

    public static void test2() throws DataException {
        try {
            int i = 9 / 0;
        } catch (ArithmeticException e) {
            throw new DataException("data is not valid", e);
        }
    }

    public static void main(String[] args) throws DataException {
        TestDataException.test2();
    }

}
```

```java
package customException;

import java.io.Serializable;

public class DAOException extends Exception implements Serializable {

    private ErrorCode erroCode;

    public ErrorCode getErroCode() {
        return erroCode;
    }

    /**
     *
     */
    private static final long serialVersionUID = 1L;

    DAOException(String msg, Throwable t) {
        super(msg, t);
```

```java
        }

        DAOException(String msg) {
                super(msg);
        }

        DAOException(ErrorCode erroCode,String msg, Throwable t) {
                super(msg, t);
                this.erroCode = erroCode;
        }
}

package customException;

public enum ErrorCode {

        INVALID_DATA,
        INVALID_STATAE,
        INVALID_CITY;

}

package customException;

public class TestException {

        public static void test1(int a) throws DAOException{
                if(a<10){
                        throw new DAOException("data is not valid");
                }
        }

        public static void test2() throws DAOException{
                try {
                        int i = 9/0;
                } catch (ArithmeticException e) {
                        throw new DAOException("data is not valid", e);
                }
        }

        public static void test3() throws DAOException{
                try {
                        int i = 9/0;
                } catch (ArithmeticException e) {
```

```
                    throw new DAOException(ErrorCode.INVALID_DATA,"data is not
valid", e);
            }
        }

        public static void main(String[] args) throws DAOException{
            TestException.test2();
            TestException.test3();
        }
}
```

Difference between throw and throws

throw	throws
throw keyword is used to throw an exception explicitly.	throws keyword is used to declare an exception possible during its execution.
throw keyword is followed by an instance of Throwable class or one of its sub-classes.	throws keyword is followed by one or more Exception class names separated by commas.
throw keyword is declared inside a method body.	throws keyword is used with method signature (method declaration).
We cannot throw multiple exceptions using throw keyword.	We can declare multiple exceptions (separated by commas) using throws keyword.

Collections in Java

A Collection is a group of individual objects represented as a single unit. Java provides Collection Framework which defines several classes and interfaces to represent a group of objects as a single unit.

The Collection interface (**java.util.Collection**) and Map interface (**java.util.Map**) are the two main "root" interfaces of Java collection classes.
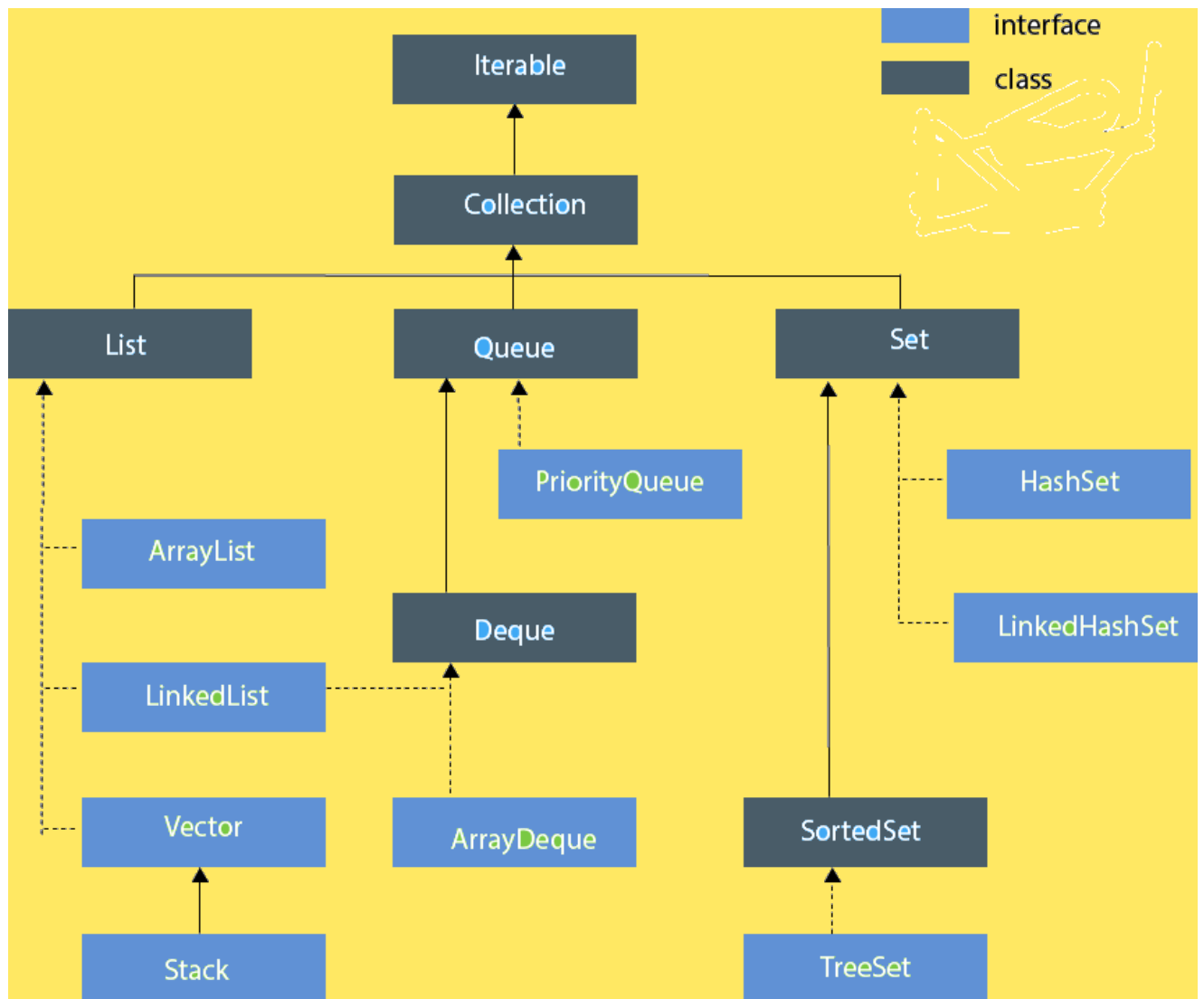
Hierarchy of Collection Framework

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An **ArrayList in Java** represent a resizable list of objects. We can add, remove, find, sort and replace elements in this list. ArrayList is part of Java's collection framework and implements Java's **List** interface.

Hierarchy of ArrayList class

Java ArrayList class extends **AbstractList** class which implements **List** interface. The List interface extends **Collection** and **Iterable** interfaces in hierarchical order.

Array List Features

Array List has following features –

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- Ordered – Elements in arraylist preserve their ordering which is by default the order in which they were added to the list.
- Index based – Elements can be randomly accessed using index positions. Index start with '0'.
- Dynamic resizing – ArrayList grows dynamically when more elements needs to be added than it's current size.
- Non synchronized – ArrayList is not synchronized, by default. Programmer needs to use synchronized keyword appropriately or simply use Vector class.
- Duplicates allowed – We can add duplicate elements in array list. It is not possible in sets.

```java
package arrayList;

import java.util.ArrayList;

public class Example1 {

	public static void main(String[] args) {
		ArrayList<String> list = new ArrayList<>();
		list.add("Test1");
		list.add("Test2");
		list.add("Test3");
		list.add("Test4");
		list.add("Test5");
	}

}
```

Addition and removal of data from array list

```java
package arrayList;

import java.util.ArrayList;

public class Example2 {

	public static void main(String[] args) {
		ArrayList<String> list = new ArrayList<>();
		list.add("Test1");
		list.add("Test2");
		list.add("Test3");
		list.add("Test4");
		list.add("Test5");
```

```java
                System.out.println(list);
                list.remove(1);
                list.remove(1);
                list.remove(1);
                list.remove(1);
                System.out.println("After data removal from list");
                System.out.println(list);
        }

}
```

Iterate Array List

```java
package arrayList;

import java.util.ArrayList;
import java.util.Iterator;

public class Example3 {

        public static void main(String[] args) {
                ArrayList<String> list = new ArrayList<>();
                list.add("Test1");
                list.add("Test2");
                list.add("Test3");
                list.add("Test4");
                list.add("Test5");
                System.out.println(list);
                System.out.println("");
                System.out.println("Iterate ArrayList Through For Loop");
                for (int i = 0; i < list.size(); i++) {
                        System.out.println(list.get(i));
                }

                System.out.println("Iterate ArrayList Through For Each Loop");
                for (String li : list) {
                        System.out.println(li);
                }

                System.out.println("Iterate ArrayList Through Iterator");
                Iterator<String> itr = list.iterator();
                while(itr.hasNext()){
                        System.out.println(itr.next());
                }
```

```
        }
}
```

ArrayList addAll() method example

```java
package arrayList;

import java.util.ArrayList;

public class Example4 {

        public static void main(String[] args) {
                ArrayList<String> list = new ArrayList<>();
                list.add("Test1");
                list.add("Test2");
                list.add("Test3");
                list.add("Test4");
                list.add("Test5");
                System.out.println(list);

                ArrayList<String> list1 = new ArrayList<>();
                list1.add("Test11");
                list1.add("Test21");

                list.addAll(list1);

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

ArrayList clear() method example

```java
package arrayList;

import java.util.ArrayList;

public class Example5 {

        public static void main(String[] args) {
                ArrayList<String> list = new ArrayList<>();
                list.add("Test1");
                list.add("Test2");
                list.add("Test3");
```

```java
        list.add("Test4");
        list.add("Test5");

        list.clear();

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

How to add Custom object to array List

```java
package arrayList;

public class Student {

    private int age;
    private String name;
    private String school;

    public Student(int age, String name, String school) {
        super();
        this.age = age;
        this.name = name;
        this.school = school;
    }

    @Override
    public String toString() {
        return "Student [age=" + age + ", name=" + name + ", school=" + school + "]";
    }

}

package arrayList;

import java.util.ArrayList;
import java.util.List;

public class Example8 {

    public static void main(String[] args) {
        List<Student> list = new ArrayList<>();
        list.add(new Student(10, "Amit", "DS"));
        list.add(new Student(11, "Mohan", "AS"));
```

```
            list.add(new Student(12, "Ram", "GS"));
            list.add(new Student(13, "Suresh", "KS"));
            list.add(new Student(14, "Bhanu", "DK"));

            System.out.println(list);
        }

}
```

ArrayList clone()

ArrayList clone() method is used to create a **shallow copy** of the list. In the new list, only object references are copied.

If we change the object state inside first arraylist, then changed object state will be reflected in cloned arraylist as well.

Learn About Cloning

What is Java clone?

So cloning is about creating the copy of original object. Its dictionary meaning is : "make an identical copy of".

By default, java cloning is 'field by field copy' i.e. as the Object class does not have idea about the structure of class on which clone() method will be invoked.

So, JVM when called for cloning, do following things:

If the class has only primitive data type members then a completely new copy of the object will be created and the reference to the new object copy will be returned.
If the class contains members of any class type then only the object references to those members are copied and hence the member references in both the original object as well as the cloned object refer to the same object.
Apart from above default behavior, you can always override this behavior and specify your own. This is done using overriding clone() method.

Java Cloneable interface and clone() method
Every language which supports cloning of objects has its own rules and so does java. In java, if a class needs to support cloning it has to do following things:

You must implement Cloneable interface.

You must override clone() method from Object class.

Java clone() method
/*
Creates and returns a copy of this object. The precise meaning of "copy" may depend on the class of the object.
The general intent is that, for any object x, the expression:
1) x.clone() != x will be true
2) x.clone().getClass() == x.getClass() will be true, but these are not absolute requirements.
3) x.clone().equals(x) will be true, this is not an absolute requirement.
*/

protected native Object clone() throws CloneNotSupportedException;

1. First statement **guarantees** that cloned object will have separate memory address assignment.
2. Second statement **suggest** that original and cloned objects should have same class type, but it is not mandatory.
3. Third statement **suggest** that original and cloned objects should have be equal using equals() method, but it is not mandatory.

Let's understand **Java clone with example**. Our first class is `Employee` class with 3 attributes – `id, name` **and** `department.`

Shallow clone is *"default implementation"* in Java. In overridden clone method, if you are not cloning all the object types (not primitives), then you are making a shallow copy.

package arrayList;

public class Employee **implements** Cloneable {

    private int empoyeeId;
    private String employeeName;
    private Department department;

    public Employee(**int** id, String name, Department dept) {
        this.empoyeeId = id;
        this.employeeName = name;
        this.department = dept;
    }

```java
		@Override
		protected Object clone() throws CloneNotSupportedException {
				return super.clone();
		}

		public int getEmpoyeeId() {
				return empoyeeId;
		}

		public void setEmpoyeeId(int empoyeeId) {
				this.empoyeeId = empoyeeId;
		}

		public String getEmployeeName() {
				return employeeName;
		}

		public void setEmployeeName(String employeeName) {
				this.employeeName = employeeName;
		}

		public Department getDepartment() {
				return department;
		}

		public void setDepartment(Department department) {
				this.department = department;
		}
}

package arrayList;

public class Department {

		private int id;
		private String name;

		public Department(int id, String name) {
				this.id = id;
				this.name = name;
		}

		public int getId() {
				return id;
```

```java
        }

        public void setId(int id) {
                this.id = id;
        }

        public String getName() {
                return name;
        }

        public void setName(String name) {
                this.name = name;
        }

}

package arrayList;

public class TestCloning {

        public static void main(String[] args) throws CloneNotSupportedException {

                Department dept = new Department(1, "Human Resource");
                Employee original = new Employee(1, "Admin", dept);

                // Lets create a clone of original object
                Employee cloned = (Employee) original.clone();

                // Let verify using employee id, if cloning actually workded
                System.out.println(cloned.getEmpoyeeId());

                // Verify JDK's rules

                // Must be true and objects must have different memory addresses
                System.out.println(original != cloned);

                // As we are returning same class; so it should be true
                System.out.println(original.getClass() == cloned.getClass());

                // Default equals method checks for references so it should be false. If
                // we want to make it true,
                // then we need to override equals method in Employee class.
                System.out.println(original.equals(cloned));
        }
```

```java
}

package arrayList;

public class TestCloning1 {

	public static void main(String[] args) throws CloneNotSupportedException {

		Department hr = new Department(1, "Human Resource");
		Employee original = new Employee(1, "Admin", hr);
		Employee cloned = (Employee) original.clone();

		// Let change the department name in cloned object and we will verify in
		// original object
		cloned.getDepartment().setName("Finance");

		System.out.println(original.getDepartment().getName());
		System.out.println(cloned.getDepartment().getName());
	}
}
```

Oops, cloned object changes are visible in original also. This way cloned objects can make havoc in the system if allowed to do so. Anybody can come and clone your application objects and do whatever he likes. Can we prevent this??

Answer is yes,

Deep clone is the desired behavior in most the cases. In the deep copy, we create a clone which is independent of original object and making changes in the cloned object should not affect original object.

```java
package arrayList;

public class Employee1 implements Cloneable {

	private int empoyeeId;
	private String employeeName;
	private Department1 department;

	public Employee1(int id, String name, Department1 dept) {
		this.empoyeeId = id;
		this.employeeName = name;
		this.department = dept;
	}
```

```java
// Modified clone() method in Employee class
@Override
protected Object clone() throws CloneNotSupportedException {
        Employee1 cloned = (Employee1) super.clone();
        cloned.setDepartment((Department1) cloned.getDepartment().clone());
        return cloned;
}

public int getEmpoyeeId() {
        return empoyeeId;
}

public void setEmpoyeeId(int empoyeeId) {
        this.empoyeeId = empoyeeId;
}

public String getEmployeeName() {
        return employeeName;
}

public void setEmployeeName(String employeeName) {
        this.employeeName = employeeName;
}

public Department1 getDepartment() {
        return department;
}

public void setDepartment(Department1 department) {
        this.department = department;
}
}


package arrayList;

public class Department1 implements Cloneable {

        private int id;
        private String name;

        public Department1(int id, String name) {
                this.id = id;
```

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```java
            this.name = name;
        }

        public int getId() {
            return id;
        }

        public void setId(int id) {
            this.id = id;
        }

        public String getName() {
            return name;
        }

        public void setName(String name) {
            this.name = name;
        }

        @Override
        protected Object clone() throws CloneNotSupportedException {
          return super.clone();
        }

}
package arrayList;

public class TestCloning2 {

        public static void main(String[] args) throws CloneNotSupportedException {

                Department1 hr = new Department1(1, "Human Resource");

                Employee1 original = new Employee1(1, "Admin", hr);
                Employee1 cloned = (Employee1) original.clone();

                // Let change the department name in cloned object and we will verify in
                // original object
                cloned.getDepartment().setName("Finance");

                System.out.println(original.getDepartment().getName());
                System.out.println(cloned.getDepartment().getName());
        }
}
```

Java ArrayList contains() – Check if element exists

```java
package arrayList;

import java.util.ArrayList;

public class Example9 {

    public static void main(String[] args) {
        ArrayList<String> list = new ArrayList<>();
        list.add("Test1");
        list.add("Test2");
        list.add("Test3");
        list.add("Test4");
        list.add("Test5");

        list.contains("Test1");
    }

}
```

ArrayList indexOf() example to check if element exists

contains() method uses indexOf() method to determine if a specified element is present in the list or not. So we can also directly use the indexOf() method to check the existance of any supplied element value.

```java
package arrayList;

import java.util.ArrayList;

public class Example10 {

    public static void main(String[] args) {
        {
            ArrayList<String> list = new ArrayList<>(2);
            list.add("A");
            list.add("B");
            list.add("C");
            list.add("D");
            System.out.println(list.indexOf("A") > 0); // true
```

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```
                System.out.println(list.indexOf("Z") > 0); // false
            }
        }
    }
```

Arraylist indexOf() – Get index of element in arraylist

This method returns the index of the first occurrence of the specified element in this list. It will return '-1'if the list does not contain the element.

```
package arrayList;

import java.util.ArrayList;
import java.util.Arrays;

public class Example11 {

    public static void main(String[] args) {

        ArrayList<String> list = new ArrayList<>(
                Arrays.asList("test1", "test2", "test3", "test4", "test5", "test6",
"test7", "test8"));

        int firstIndex = list.indexOf("test3");

        System.out.println(firstIndex);

        firstIndex = list.indexOf("hello");

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

Arraylist lastIndexOf() – Get last index of element in arraylist in Java

This method returns the index of the last occurrence of the specified element in this list. It will return '-1' if the list does not contain the element.

```
package arrayList;

import java.util.ArrayList;
import java.util.Arrays;

public class Example12 {
```

```java
        public static void main(String[] args) {
                ArrayList<String> list = new ArrayList<>(
                                Arrays.asList("test7", "test2", "test3", "test4", "test5", "tset6",
"trset7", "test8"));

                int lastIndex = list.lastIndexOf("test7");

                System.out.println(lastIndex);

                lastIndex = list.lastIndexOf("hello");

                System.out.println(lastIndex);
        }

}
```

ArrayList removeAll() method example

```java
package arrayList;

import java.util.ArrayList;

public class Example13 {

        public static void main(String[] args) {
                ArrayList<String> list = new ArrayList<>();
                list.add("Test1");
                list.add("Test2");
                list.add("Test3");
                list.add("Test4");
                list.add("Test5");

                System.out.println(list);

                list.removeAll(list);

                System.out.println(list);
        }
}

package arrayList;

import java.util.ArrayList;
```

```
public class Example14 {

    public static void main(String[] args) {
        ArrayList<String> list = new ArrayList<>();
        list.add("Test1");
        list.add("Test2");
        list.add("Test3");
        list.add("Test4");
        list.add("Test5");

        System.out.println(list);

        ArrayList<String> list1 = new ArrayList<>();
        list1.add("Test1");
        list1.add("Test2");
        list1.add("Test3");

        list.removeAll(list1);

        System.out.println(list);
    }

}
```

ArrayList retainAll() method example

ArrayList retainAll() retains only the elements in this list that are contained in the specified method argument collection. Rest all elements are removed from the list. This method is exact opposite to removeAll() method.

```
package arrayList;

import java.util.ArrayList;

public class Example15 {

    public static void main(String[] args) {
        ArrayList<String> list = new ArrayList<>();
        list.add("Test1");
        list.add("Test2");
        list.add("Test3");
        list.add("Test4");
        list.add("Test5");
```

```java
            System.out.println(list);

            ArrayList<String> list1 = new ArrayList<>();
            list1.add("Test1");
            list1.add("Test2");
            list1.add("Test3");

            list.retainAll(list1);

            System.out.println(list);
        }

    }
```

ArrayList replaceAll() method example

ArrayList replaceAll() retains only the elements in this list that are contained in the specified method argument collection. Rest all elements are removed from the list. This method is exact opposite to removeAll() method.

```java
package arrayList;

import java.util.ArrayList;
import java.util.Collections;

public class Example16 {

        public static void main(String[] args) {
                ArrayList<String> list = new ArrayList<>();
                list.add("Test1");
                list.add("Test2");
                list.add("Test3");
                list.add("Test4");
                list.add("Test1");

                System.out.println(list);

                Collections.replaceAll(list, "Test1","Test30");

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

```java
package arrayList;

public class Example19 {

    public static void main(String args[]) {
        String Str = new String("Welcome to learnjava.com");

        System.out.print("Return Value :");
        System.out.println(Str.replaceAll("(.*)learnjava(.*)", "youtube"));
    }
}
```

```java
package arrayList;

public class Example20 {

    public static void main(String args[]) {
        String str = "String replaceAll() method example!!";
        String strRegExTest = "Java 12 23 String 4 Replace Example";
        String strObj = null;

        // Replace all occurrences of "t" to "T"
        strObj = str.replaceAll("t", "T");
        System.out.println(strObj);

        // Remove all occurrences of "!"
        strObj = str.replaceAll("!", "");
        System.out.println(strObj);

        // Replace "example" to "Example"
        strObj = str.replaceAll("example", "Example");
        System.out.println(strObj);

        // Remove all the numbers
        strObj = strRegExTest.replaceAll("[0-9]+", "");
        System.out.println(strObj);

        // Replace all the words to "Word"
        strObj = strRegExTest.replaceAll("[a-zA-Z]+", "Word");
```

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


    }
}
```

ArrayList sort()

```java
package arrayList;

import java.util.ArrayList;
import java.util.Collections;

public class Example17 {

    public static void main(String[] args) {
        ArrayList<Integer> list = new ArrayList<>();
        list.add(10);
        list.add(9);
        list.add(20);
        list.add(11);
        list.add(15);

        System.out.println("before sorting="+list);

        Collections.sort(list);

        System.out.println("After sorting="+list);
    }

}

package arrayList;

import java.util.ArrayList;
import java.util.Collections;

public class Example18 {

    public static void main(String[] args) {
        ArrayList<String> list = new ArrayList<>();
        list.add("Shyam");
        list.add("Bdanu");
        list.add("Ram");
```

```
        list.add("Amit");
        list.add("Baoy");

        System.out.println("before sorting=" + list);

        Collections.sort(list);

        System.out.println("After sorting=" + list);
    }
}
```

ArrayList sort() – Sort list of objects by field

Comparators are most useful when we want to sort a given list of objects – but **not in natural order**.

Java Comparator interface is used to order the objects of a user-defined class.

This interface is found in java.util package and contains 2 methods compare(Object obj1,Object obj2) and equals(Object element).

It provides multiple sorting sequences.

package arrayList;

public class State {

```
        private int population;
        private String district;
        private String language;

        public int getPopulation() {
                return population;
        }

        public void setPopulation(int population) {
                this.population = population;
        }

        public String getDistrict() {
                return district;
        }
```

```java
        public void setDistrict(String district) {
                this.district = district;
        }

        public String getLanguage() {
                return language;
        }

        public void setLanguage(String language) {
                this.language = language;
        }

        public State(int population, String district, String language) {
                super();
                this.population = population;
                this.district = district;
                this.language = language;
        }

        @Override
        public String toString() {
                return "State [population=" + population + ", district=" + district + ",
language=" + language + "]";
        }
}

package arrayList;

import java.util.Comparator;

public class LanguageSorter implements Comparator<State> {

        @Override
        public int compare(State o1, State o2) {
                return o1.getLanguage().compareToIgnoreCase(o2.getLanguage());
        }
}

package arrayList;

import java.util.Comparator;

public class PopulationSorter implements Comparator<State> {
```

```java
        @Override
        public int compare(State o1, State o2) {
                if (o1.getPopulation() == o2.getPopulation())
                        return 0;
                else if (o1.getPopulation() > o2.getPopulation())
                        return 1;
                else
                        return -1;
        }
}


package arrayList;

import java.util.Comparator;

public class DistrictSorter implements Comparator<State>{

        @Override
        public int compare(State o1, State o2) {
                return o1.getDistrict().compareTo(o2.getDistrict());
        }

}



package arrayList;

import java.util.ArrayList;
import java.util.Collections;
import java.util.List;

public class TestObjectSorting {

        public static void main(String[] args) {
                List<State> list = new ArrayList<State>();
                list.add(new State(100, "AB", "BB"));
                list.add(new State(500, "DC", "CC"));
                list.add(new State(300, "BC", "AA"));
                list.add(new State(800, "FC", "FF"));
                list.add(new State(600, "ED", "EE"));

                list.sort(new PopulationSorter());
                System.out.println(list);
```

```java
		//Collections.sort(list,new LanguageSorter());
		//System.out.println(list);

		list.sort(new LanguageSorter());
		System.out.println(list);

		Collections.sort(list,new DistrictSorter());
		System.out.println(list);

	}

}
```

ArrayList.subList() method

subList() Method Parameters
fromIndex – start index in existing arraylist. It is inclusive.
toIndex – last index in existing arraylist. It is exclusive.

```java
package arrayList;

import java.util.ArrayList;
import java.util.Arrays;

public class Example21 {

	public static void main(String[] args) {
		ArrayList<Integer> list = new ArrayList<>(Arrays.asList(0, 10, 20, 30, 40, 50,
60, 70, 80, 90));

		ArrayList<Integer> sublist = new ArrayList<Integer>(list.subList(2, 6));

		System.out.println(sublist);
	}

}
```

Java ArrayList toArray()

```java
package arrayList;

import java.util.ArrayList;
import java.util.Arrays;
```

```java
public class Example22 {

    public static void main(String[] args) {

        ArrayList<String> list = new ArrayList<>(2);

        list.add("A");
        list.add("B");
        list.add("C");
        list.add("D");

        // Convert to object array
        Object[] array = list.toArray();

        System.out.println(Arrays.toString(array));

        // Iterate and convert to desired type
        for (Object o : array) {
            String s = (String) o;

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

ArrayList addAll() method

ArrayList addAll() method is used to append all of the elements of argument collection to the list at the end.

```java
package arrayList;

import java.util.ArrayList;

public class Example23 {

    public static void main(String[] args) {
        ArrayList<String> list = new ArrayList<>(2);

        list.add("A");
        list.add("B");
        list.add("C");
```

```java
        list.add("D");

        ArrayList<String> list1 = new ArrayList<>(2);

        list1.add("E");
        list1.add("F");
        list1.add("G");
        list1.add("H");

        list.addAll(list1);

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

ArrayList clear()

ArrayList clear() method is used to removes all of the elements from the list. The list will be empty after this call returns.

```java
package arrayList;

import java.util.ArrayList;

public class Example23 {

    public static void main(String[] args) {
        ArrayList<String> list = new ArrayList<>(2);

        list.add("A");
        list.add("B");
        list.add("C");
        list.add("D");

        ArrayList<String> list1 = new ArrayList<>(2);

        list1.add("E");
        list1.add("F");
        list1.add("G");
        list1.add("H");

        list.addAll(list1);

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

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

Java LinkedList class

Java LinkedList class is doubly-linked list implementation of the List and <u>Deque</u> interfaces. It implements all optional list operations, and permits all elements (including null).

LinkedList Features
- Doubly linked list implementation which implements List and Deque interfaces. Therefore, It can also be used as a Queue, Deque or Stack.
- Permits all elements including duplicates and NULL.
- LinkedList maintains the insertion order of the elements.
- It is not synchronized. If multiple threads access a linked list concurrently, and at least one of the threads modifies the list structurally, it must be synchronized externally.
- Use Collections.synchronizedList(new LinkedList()) to get synchronized linkedlist.
- The iterators returned by this class are fail-fast and may throw ConcurrentModificationException.
- It does not implement RandomAccess interface. So we can access elements in sequential order only. It does not support accessing elements randomly.
- We can use ListIterator to iterate LinkedList elements.

LinkedList Methods
- boolean add(Object o) : appends the specified element to the end of a list.
- void add(int index, Object element) : inserts the specified element at the specified position index in a list.
- void addFirst(Object o) : inserts the given element at the beginning of a list.
- void addLast(Object o) : appends the given element to the end of a list.
- int size() : returns the number of elements in a list
- boolean contains(Object o) : return true if the list contains a specified element, else false.
- boolean remove(Object o) : removes the first occurence of the specified element in a list.
- Object getFirst() : returns the first element in a list.
- Object getLast() : returns the last element in a list.
- int indexOf(Object o) : returns the index in a list of the first occurrence of the specified element, or -1 if the list does not contain specified element.

- lastIndexOf(Object o) : returns the index in a list of the last occurrence of the specified element, or -1 if the list does not contain specified element.
- Iterator iterator() : returns an iterator over the elements in this list in proper sequence.
- Object[] toArray() : returns an array containing all of the elements in this list in proper sequence.
- List subList(int fromIndex, int toIndex) : returns a view of the portion of this list between the specified fromIndex (inclusive) and toIndex (exclusive).

Linked List Add Methods

```java
package linkedList;

import java.util.LinkedList;
import java.util.ListIterator;

public class Example1 {

	public static void main(String[] args) {
		{
			LinkedList<String> linkedList = new LinkedList<>();

			linkedList.add("A");
			linkedList.add("B");
			linkedList.add("C");
			linkedList.add("D");

			System.out.println(linkedList);

			linkedList.add(4, "4A");
			linkedList.add(5, "5A");

			linkedList.addFirst("TT");
			linkedList.addLast("LL");

			System.out.println(linkedList);

			ListIterator<String> itrator = linkedList.listIterator();
			while (itrator.hasNext()) {
				System.out.println(itrator.next());
			}
		}
	}
}
```

```java
package linkedList;

import java.util.LinkedList;

public class Example3 {

    public static void main(String[] args) {

        LinkedList<String> linkedList = new LinkedList<>();

        linkedList.add("A");
        linkedList.add("B");
        linkedList.add("C");
        linkedList.add("D");

        LinkedList<String> linkedList1 = new LinkedList<>();

        linkedList1.add("AA");
        linkedList1.add("BB");
        linkedList1.add("CC");
        linkedList1.add("DD");

        linkedList.addAll(linkedList1);

        System.out.println(linkedList);

        linkedList.addAll(1, linkedList1);

        System.out.println(linkedList);

    }
}
```

Linked List Get Methods

```java
package linkedList;

import java.util.LinkedList;

public class Example2 {

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

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```
                {
                        LinkedList<String> linkedList = new LinkedList<>();

                        linkedList.add("A");
                        linkedList.add("B");
                        linkedList.add("C");
                        linkedList.add("D");

                        System.out.println(linkedList.get(0));
                        System.out.println(linkedList.getFirst());
                        System.out.println(linkedList.getLast());
                }
        }
}
```

ArrayList vs LinkedList

- ArrayList is implemented with the concept of dynamic resizable array. While LinkedList is a doubly linked list implementation.
- ArrayList allows random access to it's elements while LinkedList does not.
- LinkedList, also implements Queue interface which adds more methods than ArrayList, such as offer(), peek(), poll(), etc.
- While comparing to LinkedList, ArrayList is slower in add and remove, but faster in get, because there is no need of resizing array and copying content to new array if array gets full in LinkedList.
- LinkedList has more memory overhead than ArrayList because in ArrayList each index only holds actual object but in case of LinkedList each node holds both data and address of next and previous node.

Java HashSet

The important points about Java HashSet class are:

- HashSet stores the elements by using a mechanism called **hashing.**
- HashSet contains unique elements only.
- HashSet allows null value.
- HashSet class is non synchronized.
- HashSet doesn't maintain the insertion order. Here, elements are inserted on the basis of their hashcode.
- HashSet is the best approach for search operations.
- The initial default capacity of HashSet is 16, and the load factor is 0.75.

Constructor	Description
HashSet()	It is used to construct a default HashSet.
HashSet(int capacity)	It is used to initialize the capacity of the hash set to the given integer value capacity. The capacity grows automatically as elements are added to the HashSet.
HashSet(int capacity, float loadFactor)	It is used to initialize the capacity of the hash set to the given integer value capacity and the specified load factor.
HashSet(Collection<? extends E> c)	It is used to initialize the hash set by using the elements of the collection c.

Return Type	Method	Description
boolean	add(E e)	It is used to add the specified element to this set if it is not already present.
void	clear()	It is used to remove all of the elements from the set.
object	clone()	It is used to return a shallow copy of this HashSet instance: the elements themselves are not cloned.
boolean	contains(Object o)	It is used to return true if this set contains the specified element.
boolean	isEmpty()	It is used to return true if this set contains no elements.
Iterator<E>	iterator()	It is used to return an iterator over the elements in this set.
boolean	remove(Object o)	It is used to remove the specified element from this set if it is present.
int	size()	It is used to return the number of elements in the set.
Spliterator<E>	spliterator()	It is used to create a late-binding and fail-fast Spliterator over the elements in the set.

```
package setClass;

import java.util.HashSet;
import java.util.Iterator;

public class Example1 {

	public static void main(String[] args) {
		HashSet<String> set = new HashSet<String>();

		set.add("Test1");
		set.add("Test2");
		set.add("Test3");
		set.add("Test4");
```

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```java
                set.add("Test5");
                Iterator<String> i = set.iterator();
                while (i.hasNext()) {
                        System.out.println(i.next());
                }
        }
}
```

Java HashSet example ignoring duplicate elements

```java
package setClass;

import java.util.HashSet;
import java.util.Iterator;

public class Example2 {

        public static void main(String args[]) {
                HashSet<String> set = new HashSet<String>();
                set.add("Test1");
                set.add("Test2");
                set.add("Test3");
                set.add("Test2");
                Iterator<String> itr = set.iterator();
                while (itr.hasNext()) {
                        System.out.println(itr.next());
                }
        }
}
```

HashSet example to remove elements

```java
package setClass;

import java.util.HashSet;

public class Example3 {

        public static void main(String[] args) {
                HashSet<String> set = new HashSet<String>();
                set.add("Test1");
                set.add("Test2");
                set.add("Test3");
                set.add("Test4");
```

```java
            System.out.println("An initial list of elements: " + set);
            set.remove("Test1");
            System.out.println("After invoking remove(object) method: " + set);
            HashSet<String> set1 = new HashSet<String>();
            set1.add("Test2");
            set1.add("Test3");
            set.addAll(set1);
            System.out.println("Updated List: " + set);
            set.removeAll(set1);
            System.out.println("After invoking removeAll() method: " + set);
            set.clear();
            System.out.println("After invoking clear() method: " + set);
        }
}
```

Storing custom Object in Hash map

```java
package setClass;

public class Book {

        int id;
        String name, author, publisher;
        int quantity;

        public Book(int id, String name, String author, String publisher, int quantity) {
                this.id = id;
                this.name = name;
                this.author = author;
                this.publisher = publisher;
                this.quantity = quantity;
        }
}
```

```java
package setClass;

import java.util.HashSet;

public class Example4 {

        public static void main(String[] args) {

                HashSet<Book> set = new HashSet<Book>();
```

```java
        Book b1 = new Book(11, "Test1", "author1", "publisher1", 8);
        Book b2 = new Book(12, "Test2", "author2", "publisher2", 4);
        Book b3 = new Book(13, "Test3", "author3", "publisher3", 6);
        set.add(b1);
        set.add(b2);
        set.add(b3);
        for (Book book : set) {
            System.out.println(
                    book.id + " " + book.name + " " + book.author + " " +
book.publisher + " " + book.quantity);
        }
    }
}
```

Java LinkedHashSet class

The important points about Java LinkedHashSet class are:

- Java LinkedHashSet class contains unique elements only like HashSet.
- Java LinkedHashSet class provides all optional set operation and permits null elements.
- Java LinkedHashSet class is non synchronized.
- Java LinkedHashSet class maintains insertion order.


```java
package setClass;

import java.util.HashSet;
import java.util.Iterator;
import java.util.LinkedHashSet;

public class Example5 {

    public static void main(String args[]) {

        HashSet<String> set = new HashSet<String>();
        set.add("Test1");
        set.add("Test40");
        set.add("Test3");
        set.add("Test2");
        set.add("Test20");
        set.add("Test2");
```

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```
Iterator<String> itr = set.iterator();
while (itr.hasNext()) {
        System.out.println(itr.next());
}
System.out.println("=========");
LinkedHashSet<String> linkedset = new LinkedHashSet<String>();
linkedset.add("Test1");
linkedset.add("Test40");
linkedset.add("Test3");
linkedset.add("Test2");
linkedset.add("Test20");
linkedset.add("Test2");
Iterator<String> itr1 = linkedset.iterator();
while (itr1.hasNext()) {
        System.out.println(itr1.next());
}
    }
}
```

Test1
Test40
Test20
Test3
Test2
=========
Test1
Test40
Test3
Test2
Test20

TreeSet

The important points about Java TreeSet class are:

- Java TreeSet class contains unique elements only like HashSet.
- Java TreeSet class access and retrieval times are quiet fast.
- Java TreeSet class doesn't allow null element.
- Java TreeSet class is non synchronized.
- Java TreeSet class maintains ascending order.

```java
package setClass;

import java.util.Iterator;
import java.util.LinkedHashSet;
import java.util.TreeSet;

public class Example6 {

    public static void main(String[] args) {
        TreeSet<Integer> set = new TreeSet<Integer>();
        set.add(10);
        set.add(40);
        set.add(900);
        set.add(50);
        set.add(6);
        set.add(70);
        Iterator<Integer> itr = set.iterator();
        while (itr.hasNext()) {
            System.out.println(itr.next());
        }
        System.out.println("===========");
        TreeSet<String> set1 = new TreeSet<String>();
        set1.add("ABC");
        set1.add("BCD");
        set1.add("EFG");
        set1.add("XXX");
        set1.add("CAB");
        Iterator<String> itr1 = set1.iterator();
        while (itr1.hasNext()) {
            System.out.println(itr1.next());
        }
        System.out.println("===========");
        LinkedHashSet<String> set2 = new LinkedHashSet<String>();
        set2.add("ABC");
        set2.add("BCD");
        set2.add("EFG");
        set2.add("XXX");
        set2.add("CAB");
        Iterator<String> itr2 = set2.iterator();
        while (itr2.hasNext()) {
            System.out.println(itr2.next());
        }
    }
}
```

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Hash Map Class

Points to remember

- Java HashMap class contains values based on the key.
- Java HashMap class contains only unique keys.
- Java HashMap class may have one null key and multiple null values.
- Java HashMap class is non synchronized.
- Java HashMap class maintains no order.

```java
package mapClass;

import java.util.HashMap;

public class Example1 {

    public static void main(String[] args) {
        HashMap<String, String> map = new HashMap<>();
        map.put("Test1", "A");
        map.put("Test2", "B");
        map.put("Test3", "C");
        map.put("Test4", "D");
        System.out.println(map);
    }

}
```

Constructor In HashMap

Constructor	Description
HashMap()	It is used to construct a default HashMap.
HashMap(Map<? extends K,? extends V> m)	It is used to initialize the hash map by using the elements of the given Map object m.
HashMap(int capacity)	It is used to initializes the capacity of the hash map to the given integer value, capacity.
HashMap(int capacity, float loadFactor)	It is used to initialize both the capacity and load factor of the hash map by using its arguments.

Iterator Over HashMap

```java
package mapClass;

import java.util.HashMap;
import java.util.Map;

public class Example1 {

    public static void main(String[] args) {
        HashMap<String, String> map = new HashMap<>();
        map.put("Test1", "A");
        map.put("Test2", "B");
        map.put("Test3", "C");
        map.put("Test4", "D");
        System.out.println(map);

        for (Map.Entry<String, String> m : map.entrySet()) {
            System.out.println(m.getKey() + " " + m.getValue());
        }
    }

}
```

Get Data from HashMap

```java
package mapClass;

import java.util.HashMap;

public class Example3 {

    public static void main(String[] args) {

        HashMap<String, String> map = new HashMap<>();
        map.put("Test1", "A");
        map.put("Test2", "B");
        map.put("Test3", "C");
        map.put("Test4", "D");
        System.out.println(map);
```

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```java
            System.out.println(map.get("Test1"));
    }
}
```

Remove and putAll method of HashMap

```java
package mapClass;

import java.util.HashMap;

public class Example4 {

    public static void main(String[] args) {

            HashMap<String, String> map = new HashMap<>();
            map.put("Test1", "A");
            map.put("Test2", "B");
            map.put("Test3", "C");
            map.put("Test4", "D");
            System.out.println(map);
            System.out.println("=========");
            System.out.println(map.remove("Test1"));

            System.out.println(map);
            System.out.println("=========");
            HashMap<String, String> map1 = new HashMap<>();
            map1.put("Test5", "A1");
            map1.put("Test6", "B1");
            map1.put("Test7", "C1");
            map1.put("Test8", "D1");

            map.putAll(map1);
            System.out.println(map);
    }
}
```

Hash Map Methods

```java
package mapClass;
```

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```java
import java.util.HashMap;

public class Example5 {

    public static void main(String[] args) {
        HashMap<String, String> map = new HashMap<>();
        map.put("Test1", "A");
        map.put("Test2", "B");
        map.put("Test3", "C");
        map.put("Test4", "D");

        /**
         * Removes all of the mappings from this map. The map will be empty
         * after this call returns.
         */
        map.clear();

        /**
         * Returns <tt>true</tt> if this map contains a mapping for the
         * specified key.
         */
        System.out.println(map.containsKey("Test1"));

    /**
     * value whose presence in this map is to be tested
     * @return <tt>true</tt> if this map maps one or more keys to the
     *      specified value
     */
        System.out.println(map.containsValue("A"));

        map.put("Test1", "A");
        map.put("Test2", "B");
        map.put("Test3", "C");
        map.put("Test4", "D");

        System.out.println(map.containsKey("Test1"));
        System.out.println(map.containsValue("A"));
    }
}
```

Hash Map Methods

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```java
package mapClass;

import java.util.HashMap;
import java.util.Map.Entry;
import java.util.Set;

public class Example6 {

    public static void main(String[] args) {
        HashMap<String, String> map = new HashMap<>();
        map.put("Test1", "A");
        map.put("Test2", "B");
        map.put("Test3", "C");
        map.put("Test4", "D");

        /**
         * @return a set view of the mappings contained in this map.
         */
        Set<Entry<String, String>> entry = map.entrySet();

        for (Entry<String, String> entry2 : entry) {
            System.out.println(entry2.getKey() + "==" + entry2.getValue());
        }

        /**
         * Returns <tt>true</tt> if this map contains no key-value mappings.
         *
         * @return <tt>true</tt> if this map contains no key-value mappings
         */
        System.out.println(map.isEmpty());

        /**
         * Removes the mapping for the specified key from this map if present.
         */
        map.remove("Test1");

        map.replace("Test2", "Test1000");

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

Map which will take all type of data

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```java
package mapClass;

import java.util.HashMap;
import java.util.Map;

public class Example7 {

    public static void main(String[] args) {

        Map<Object, Object> map = new HashMap<>();
        map.put(10, 1000);
        map.put("Test1", "AAA");
        map.put(10.90, 10.999);
        map.put('A', 'n');

        System.out.println(map);

    }
}
```

Map to store object type data

```java
package mapClass;

import java.util.HashMap;
import java.util.Map;

public class Example8 {

    public static void main(String[] args) {

        Map<Integer, School> map = new HashMap<>();

        School s1 = new School("Test1", "20", "A");
        School s2 = new School("Test2", "30", "B");
        School s3 = new School("Test3", "40", "C");
        School s4 = new School("Test4", "50", "D");

        map.put(1, s1);
        map.put(2, s2);
```

```
        map.put(3, s3);

        // What happens when you store duplicate key
        map.put(3, s4);

        System.out.println(map);

    }
}
```

Is it possible to Store Multiple null Key and values

```
package mapClass;

import java.util.HashMap;
import java.util.Map;

public class Example9 {

    public static void main(String[] args) {

        Map<Integer, String> map = new HashMap<>();

        map.put(null, "Test1");
        map.put(null, "Test1");
        map.put(null, "Test1");
        map.put(null, "Test1");
        map.put(1, null);
        map.put(2, null);
        map.put(3, null);
        map.put(4, null);

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

Linked Hash Map and Tree Map

LinkedHashMap is a subclass of HashMap. That means it inherits the features of HashMap. In addition, the linked list preserves the insertion-order.

Map Overview

There are 4 commonly used implementations of Map in Java SE - HashMap, TreeMap, Hashtable and LinkedHashMap. If we use one sentence to describe each implementation, it would be the following:

- HashMap is implemented as a hash table, and there is no ordering on keys or values.
- TreeMap is implemented based on red-black tree structure, and it is ordered by the key.
- LinkedHashMap preserves the insertion order
- Hashtable is synchronized, in contrast to HashMap.

```java
package mapClass;

import java.util.LinkedHashMap;
import java.util.TreeMap;

public class Example10 {

    public static void main(String[] args) {

        LinkedHashMap<Integer, String> linkedHashMap = new LinkedHashMap<>();
        linkedHashMap.put(10, "Test1");
        linkedHashMap.put(11, "Test2");
        linkedHashMap.put(1000, "Test1");
        linkedHashMap.put(40, "Test4");
        linkedHashMap.put(20, "Test5");

        System.out.println(linkedHashMap);

        TreeMap<Integer, String> treeMap = new TreeMap<>();

        treeMap.put(10, "Test1");
        treeMap.put(11, "Test2");
        treeMap.put(1000, "Test1");
        treeMap.put(40, "Test4");
```

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```
            treeMap.put(20, "Test5");

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