Topics

* Core Java
* JDBC, Servlets & JSP
* HTML, CSS, Typescript, Javascript
* Git
* UML
* Junit
* Spring Framework
* Spring Boot & Microservices
* Python
* Cloud & Containers
* Design Patterns
* React.js

Java

It is a platform independent & object oriented programming language.

Platform Independent: You can run java programs on various platforms without re-compiling

Object Oriented Language: You create real world entities in the application and define the properties & behaviors of these real world entities, these real world entities are called as objects.

Two things are must in object oriented language which are also called as building blocks of an object oriented language

1. class: blueprint or template of an object
2. object: an instance created from the class

run -> entry point -> C/C++/Java -> main method

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

class Hello {   
 public static void main(String[] args) {   
 System.out.println(….);  
 }  
}

String[] - it is a command line argument which accepts the input from the user before launching the main

static - you can access static members without creating the object

public - visible outside the class

Softwares required

1. JDK - javac, java commands
2. Editor - notepad, vscode or IDE like Eclipse

Eclipse -> File -> Other -> Java Project

Fundamentals

1. Variables - these are the memory to store the data
2. Datatypes - byte, short, int, long, float, double, char, boolean, arrays & complex types
3. Operators - \*, -, +, /, ++, --, <=, >=, ==, >, <, %, !=, &&, ||
4. Conditional statements - if else .. if else if .. else, switch
5. Loops - for, while, do while
6. Jump statements - break, continue, return

Java Naming conventions

avoid using variable names like a, b, c, i, j, k, x, y, z as they don’t explain themselves what they are instead use variable names like name, age, phoneNumber, gender and so on

Similarly for methods / functions you must use the names which are having meanings like

display(), update(), getDetails(), searchEmployee(), searchCustomer() and so on, avoid using test(), demo(), abc() and so on.

While or Do While loop

While loop: It first checks the condition & then executes the loop

Do while loop: at least once the loop is executed and then the condition is checked to continue

for each or enhanced for loop iterates the elements without using the index.

Activity:

Create an array of numbers like 1, 4, 3, 6, 2, 5, 0, -5, iterate over an array and display the maximum, minimum and sum of elements in the array  
ex: Max: 6, Min: -5, Sum : 16

Note: Use only one loop to display max, min & sum

For the same array search an element 2 that must print 2 is found  
then search an element 9 that must print 9 is not found

Command line arguments: These are the inputs which you can provide while running the program so that programs can use these inputs before starting, the String[] in the main is a command line argument you can pass while using java command or in eclipse you can pass through Run As option.

i.e.,

java TestApp 20 30 40   
java TestApp Hello Everyone

Type conversion: Converting one type to another type, it can be automatic or explicit depending on the type of variable you are using

Auto-widening (Type promotion)  
int x = 25; // int = 4, long = 8  
long y = x; // type promotion

Explicit-narrowing

long x = 25; // long = 8, int = 4  
int y = (int)x; // explicit narrowing

Auto-boxing & Auto-unboxing: These are automatic because it deals with converting primitives to wrappers and vice versa

int x = 25; //  
Integer y = x; // Integer = int >> Auto-boxing, 25 will stored as an Integer object

int z = y; // int = Integer >> Auto-unboxing

class Calculator {   
void add(byte x, byte y) {   
  
 }  
}  
int a = 25;  
int b = 30;  
add((byte)a, (byte)b);

Object Oriented Programming

class: It defines the structure, it can have following members

* variables or fields
* methods: Will have reusable logics
* constructors: are called when objects are created, you can have initialization logics

object: It is an instance of a class which is created with new keyword

User user1 = new User();

Constructor vs Methods

|  |  |
| --- | --- |
| Constructor | Method |
| Constructors are called when objects are created | Methods are not called when objects are created |
| It will not have return type | It must have return type |
| Its name must be same as the class name | It’s name need not to be same as the class name, however you can give class name but they are invoked only when you call them explicitly |
| It usually will have initialization logic | It will have reusable logics |

Activity:

Create User class with id, name, constructor to initialize the id & name, display method to print id & name, in main method create 2 objects & call the display method.

Classes can have static and non-static(instance) members

static members you can access directly from the class name, however non-static members you can access only by creating the object whenever you want these members to accessed outside the class.

class User {   
 int id;

static int counter = 5;  
}  
User.counter = 7; // valid  
User.id = 33; // invalid, because id is instance variable

static members are loaded at the time class loading, non-static members are loaded at the time of object creation.



Quiz:

int x = 20;

int y = ++x;

System.out.println(y); //21  
System.out.println(x); // 21

1. class A {   
    static void demo() { test(); } // error  
    void test() { System.out.println(“hello”); }  
   }
2. class A {  
    static void demo() { A a = new A(); a.test(); } // ok  
    void test() { System.out.println(“hello”); }  
   }

}

class A {   
 // default constructor in case you have not written  
}   
class B {   
 B(int x) {   
 }  
 // only one constructor will be created which takes int parameter  
}

byte x = 30;  
long y = 40;  
int z = (int) y; //   
int z1 = x; //

Principles of OOPs

Inheritance  
Encapsulation  
Polymorphism  
Abstraction

Inheritance:

Acquiring the properties & behaviors of a class from another class, you use extends keyword to inherit   
class Person {   
 name, gender, email, dob // properties  
 display() { } // display data   
}  
class Employee extends Person {   
 employeeId, salary   
}  
class Student extends Person {   
 rollNo, grade  
}

Note:

* In Java you can achieve various types of inheritance like single level, multi-level, hierarchical, multiple(supported only through interface) & hybrid (supported only through interface)
* If a class doesn’t extend any class it automatically extends Object class
* Subclass constructors calls the default constructors of the parent class by default, however you can pass parameters to the super() to call the parameterized constructor of the parent class

Polymorphism:

A method that has many forms or a method that can do more than one job, there are two types of polymorphism

1. Compile time – overloading – method invocation is determined at compile
2. Runtime – overriding – method invocation is determined at runtime

class Person, class Employee extends Person, class Student extends Person { }   
  
Method Overriding: you will create the same method of super class in the subclass with different logic & to achieve runtime polymorphism you will use the super class reference variable and call the overridden method  
void test(long x) { }   
int a = 20; test(a);  
long b = 30; test(b);  
byte c = 40; test(c);

Method Overloading: You will create multiple methods with the same name in the same class with different signature(parameter type or order or return type)

Encapsulation: It is mechanism of hiding the data by making data private & the only way you can access the data is using public methods, private data will not be visible outside the class so that it restricts the direct access from the outsider

class Employee {   
 private int id;  
 private int age;  
 Employee(int id) { this.id = id; }  
 public void setAge(int age) { this.age = age; }  
 public int getAge() { return age; }  
 public int getId() { return id; }  
}  
Employee emp = new Employee(34);  
emp.id = 356; // error  
emp.age = 4939; // error

Abstraction:

Hides the complexity and shows only the necessary details so that it will be easy to use the object, here the developers need not to worry about how the method is implemented, instead they must know what a method does.

We achieve abstraction by creating abstract methods in 2 ways

abstract methods: These are the methods which doesn’t have logic or body

1. interface: Will have only abstract methods & constants
2. abstract class: can have both abstract methods (methods without body) & non-abstract methods (or methods with body)

interface: Methods are by default abstract & public, variables are by default public, static & final, however you can’t have constructors, hence you can’t create the object of the interface

interface UserDB {   
 void store(); // public abstract void store();  
 void delete();  
}

A class can implement the interface (a class can also implement one or more interfaces)

D4 implements the interface  
class UserDBOneImpl implements UserDB {   
 // mandatorily you must implement all the methods of interface  
}

D1 ui1(UserDB db) { db.store(); }  
D2 ui2(UserDB db) { db.delete(): }  
D3 ui3(UserDB db) { db.store(); }

D5 ui1(new UserDBOneImpl());

Customer -> login(), transfer(), getDetails(),

Employee -> deleteAccount()  
  
interface CustomerOP {   
 login(); transfer(); getDetails();  
}  
interface EmployeeOP {   
 deleteAccount();   
}  
class BankOp implements CustomerOP, EmployeeOP { 4 methods }  
Customer -> ui(CustomerOP cop) { cop.login(), cop.getDetails(), cop.transfer() }  
Employee -> ui(EmployeeOP eop) { eop.deleteAccount(); }

Abstract class

It allows you to have abstract methods and methods with body, go for abstract class when you don’t know the full implementation of the class

ex:

interface DataStructure {   
 void add(int x); // LIFO, FIFO, SO, RO, Uniqu  
 void delete(); // LIFO, FIFO, SO,   
 void findAll();  
}  
abstract class AbstractDS implements DataStructure {   
 void findAll() { … }  
}   
class StackDS extends AbstractDS {   
 // mandatorily implement all the abstract methods like add, delete  
}   
class UniqueDS extends AbstractDS {   
 // mandatorily implement all the abstract methods like add, delete  
}  
Note: Abstract class can have constructors, but you can’t create object of an abstract class

Note: From Java 8 there are few changes done in the interface

Difference between interface and abstract class

|  |  |
| --- | --- |
| Interface | Abstract class |
| All the methods are by default abstract & public | You need to explicitly use abstract keyword |
| All the fields are public, static & final | Fields are not constants unless explicitly defined |
| Can’t have constructors | Can have constructors |
| Provides full abstraction | Provides partial abstract |
| An interface can extend one or more interfaces which is called as multiple inheritance | An abstract class can extend only one class |
| We can’t instantiate | We can’t instantiate |
| More secured when you want to share the interface | Not secured when you want to share the abstract class to other developers |

Packages & Visibility of members

For visibility java has 4 access specifiers

class A {   
 private int x; //   
 int y; // default or package private  
 protected int z;   
 public int i;   
}

1. private: Visible only within the class
2. no keyword i.e., default or package private: Visible within the package
3. protected: within the package & outside the package only to the subclasses
4. public: Visible to all

package com.ibm package com.org;  
public class A { class B {   
 protected int z; // can’t access z  
} class C extends A { // z will be inherited

Exception Handling

5 keywords – try, catch, finally, throw & throws

try { }: try block should have code that might generate exception, ex: accessing the DB, accessing the files, working with remote service

catch(..) { } : catch block will handle the exceptions generated in try block, you can have multiple catch blocks

finally { } : This is absolutely executed whether or not exception handled, some mandatory statements that needs to be called like closing the files, db connections

throw: It is to manually generate an exception or user defined exception, ex: UserNotFoundException, AgeInvalidException, AccountNotFoundException, InsufficientBalanceException

throws: It is to forward the exception from one method to another when a method wants a caller to handle the exception, because caller knows what to do with the exception.

Exception hierarchy



Error you can’t handle, but Exceptions you can handle, here there are 2 types of exceptions

1. Checked exceptions, which must be handled at the compilation time using try – catch or it must be propagated using throws
2. Unchecked exceptions are subclasses of RuntimeException which are not forced to handle at the compilation time, because these exceptions are programmers mistakes that can be resolved with the proper logic

try with resource:

It is introduced in Java 7, to automatically close the resources like Files, Databases, Scanner to reduce too much try catch finally, this syntax you can use only on the classes that implement AutoCloseable or Closeable

try ( Scanner scan = new Scanner(System.in);   
FileReader reader = new FileReader(scan.next()); BufferedReader buffer = new BufferedReader(reader) )   
{  
  
}

try( String str = “hello”; ) { }// this gives compilation error

Custom exceptions

Creating exceptions of our own based on the project requirement by extending any one of the Exception class, you can extend any one of the exception class like Exception or RuntimeException, to create checked exception you can extend Exception or sub class of Exception except RuntimeException, if you extend RuntimeException it becomes unchecked.

ex: InsufficientBalanceException, AgeInvalidException, LimitExceedException and so on.

class EmployeeNotFoundException extends Exception {   
 // minimum 2 or more constructors you must create  
}

Employee find(int id) throws EmployeeNotFoundException {   
 if(…) { throw new EmployeeNotFoundException(…); }  
}

Assertions: These are used to test some results in your code, if the result is not as per the expectation then you can make assert false that can throw an assertion error, it is used only at the time of development / testing

int age = scan.nextInt();

assert (age >= 18) : “Age is less than 18”;

This works only if you enable the assertion, you get an assertion error if the assert condition is false.

By default assertions are disabled, to enable you must use -ea option in the vm argument i.e., java -ea in case you are using command prompt, else in Eclipse you need to use configuration in Run As option

Multithreading

Running more than one task at the same time, means at the same time multiple threads can run the methods by sharing the CPU time

There are mainly two ways to write multi threaded applications in Java

1. By extending the Thread class
2. Another is by implementing a Runnable interface, it has run() method that is an entry point for the threads

Note: Thread class implements Runnable interface internally

To create threads you must use Thread class that provides various methods to manage threads

Thread thread1 = new Thread(runnableTypeObject);  
Thread thread2 = new Thread(runnableTypeObject)

thread1.start(); // it registers the threads in the thread schedular

thread2.start(); // 2nd thread registers in the thread schedular

Once the threads are registered run() method logics will be executed

Thread.currentThread(): returns the currently running thread  
Thread.sleep(long): thread goes to sleep state

getName(): returns the name of the thread

setName(String): to provide the name for the thread

Executor Framework

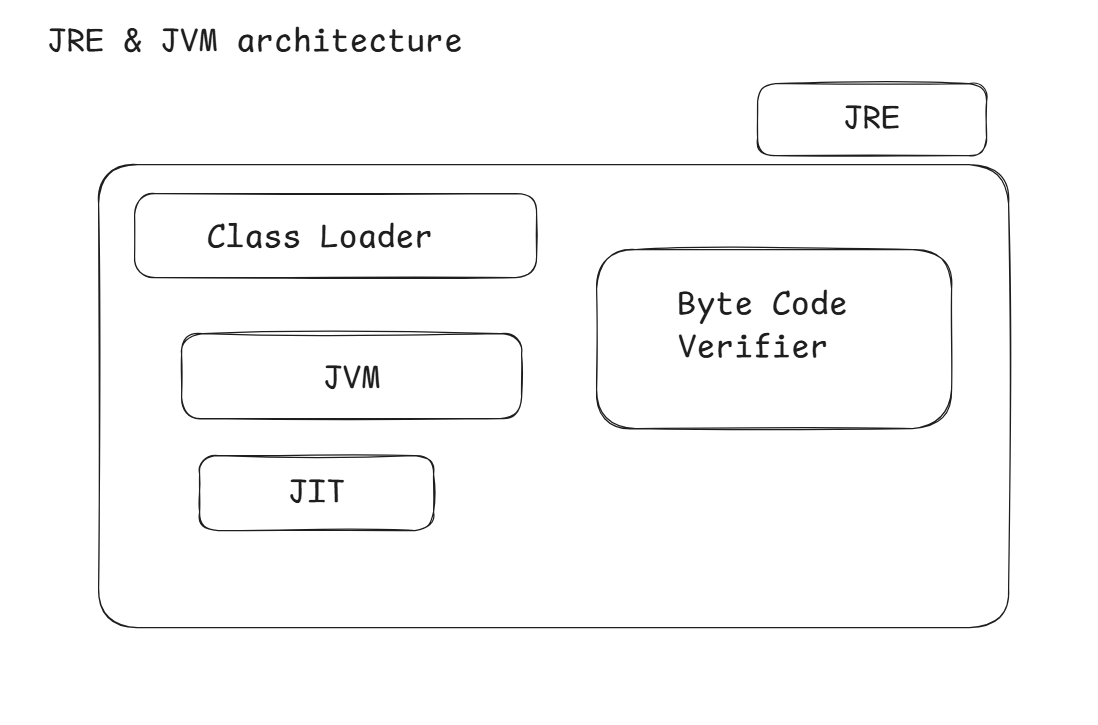
it takes care of creating the threads and allows to reuse the threads in the thread pool.

Thread t = new Thread(..); // here thread will be created & destroyed once the job is done

Executor executor = Executors.newFixedThreadPool(3);

executor.execute(runnableType);

JRE & JVM architecture & Garbage collector



Garbage collector is a thread, which takes care of marking all the objects that has no reference & remove those objects automatically so that it gives space for other objects

main() {   
 test();  
 demo();  
}  
test() {   
 A a = new A();  
 B b = new B();  
}  
demo() {   
 X x = new X();  
}

Here once the test() method is completed its execution, a & b references will be removed whose objects are eligible for garbage collection, when garbage collector marks the object it will find two types of objects.

1. object with reference
2. object without reference – only these objects will be removed.

String class

It creates an immutable string object, once string object is created you can’t modify its content.

String methods:

concat(), toUpperCase(), toLowerCase(), charAt(), length(), equals(), equalsIgnoreCase(), substring(), indexOf(), split(), strip(), isBlank() and so on.

String s1, s2, s3, s4, s5;  
s1 = “hello”;  
s2 = “hello”; // s1 == s2 >> true   
s3 = new String(“hello”); // s1 == s3 >> false  
s4 = new String(“hello”); // s3 == s4 >> false

s1.equals(s3); // compares content instead of address  
s1.concat(“123”);  
System.out.println(s1); // hello  
s1 = s1.concat(“12345”);  
System.out.println(s1); // hello123

Inner class

These are the classes that you can nest inside another class, you use nested classes when outer class is dependent on another class:

ex: Thread class is having a nested enum called State, enum is also a type of class but will have fixed set of constants.

There are four types of inner class you can create

1. Static inner class
2. Non-Static inner class
3. Anonymous class
4. Local inner class

enum: it is a type of class which helps you to create fixed set of named constants

enum Gender {   
 MALE, FEMALE  
}  
You can create a variable of Gender which can accept either MALE or FEMALE value onlye  
Gender gen1 = Gender.MALE;  
Gender gen2 = Gender.FEMALE;  
gen1 = Gender.XYZ; // error

Instead of create String gender you can create an enum Gender

Event Management System Use Case

class Event {   
 id, name, time, location, organizerNames, startDate, endDate; // properties  
 updateEvent(startDate, endDate) { }   
 updateEventTime(time) { }   
 display(id) { … } // display the event details based on the id  
}  
main method -> you can create 3 to 4 event objects -> display all the events -> updateEvent() & display the updatedEvent

Day 4 topics

1. Collection with Generics
2. IO Streams – File handling & Serialization(optional)
3. Reflection API
4. Java 8 features
5. Java 11 features
6. Java 17 features
7. HttpClient
8. Internationalization
9. Arrays
10. Object class methods
11. Java annotations - @Override, @SuppressWarning
12. Debugging
13. Interview questions

Collection Framework

Collection can maintain multiple objects and it is dynamic in nature, it has predefined classes & interfaces that can maintain the objects in various forms

Arrays are also a collection but its size is fixed & you need to write the algorithm to maintain the elements in various forms

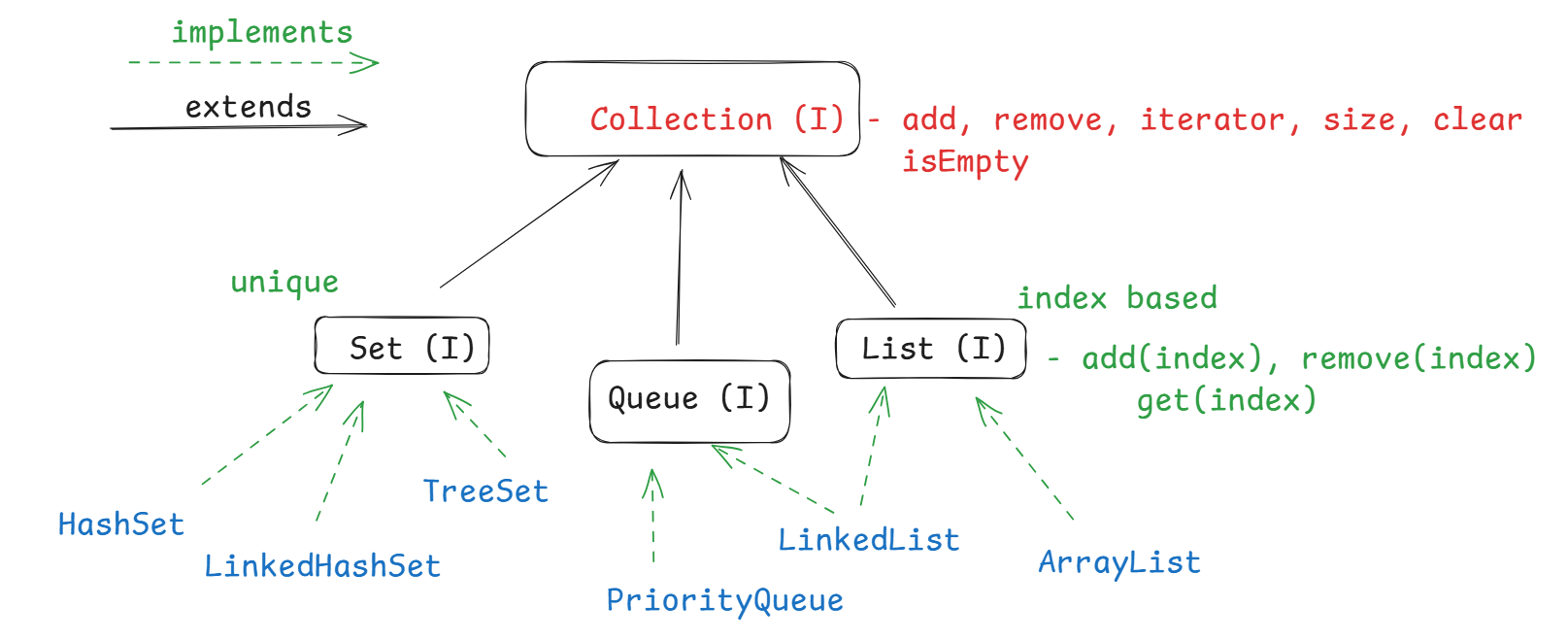
Employee[] employees = new Employee[5]; // object array

// employees can store maximum 5 employee objects, from employees[0] to employees[4]

Collection vs Array

|  |  |
| --- | --- |
| Arrays | Collections |
| Size is fixed | Size is dynamic |
| Manually you need to write algorithms to maintain elements in various forms like unique elements, sequential elements, sorting elements and so on | You get inbuilt methods to add, remove, iterate the elements |

Collection framework provides various interfaces & classes, below is the collection hierarchy



Note: You don’t need to know how these algorithm is internally implemented, instead you must know how they maintain the data

Set: Supports only unique elements  
TreeSet: Maintains the elements in sorted order, ex: storing student based on result  
LinkedHashSet: Maintains the elements in Sequential order, ex: online token based processing

HashSet: Maintains the elements in Random order, but it is faster in retrieving the data, because it uses hash based algorithm

Queue: It is used to process the data after removing, it provides methods like poll() to remove the element

PriorityQueue: It removes the element based on the priority i.e., sorted order

ex: online bidding

stock market [ order1(1000), order2(1005), order3(990) ]

LinkedList: It removes the elements in FIFO order  
ex: messaging apps

poll in Queue vs remove in Collection: poll() is part of Queue that can remove the element either in sorted order or FIFO order, however remove in Collection removes the particular element

List: It is index based

ArrayList: Maintains the elements in contiguous memory address and if the elements are added in between then other elements are shifted to different memory to maintain the contiguous memory address

ex: Use ArrayList in the application where you frequently retrieve and rarely add or remove the elements, like university applications

ArrayList adding and removing is slower & retrieval is faster

LinkedList: Maintains the elements in non-contiguous memory address, adding & removing is faster & retrieving is slower

ex: Online shopping apps

Collection can store multiple objects however storing multiple objects would be problematic at the time of retrieval hence collection uses generics to define what type of objects it will store

Without generics

List al = new ArrayList();   
al.add(5);  
al.add(88.5);  
al.add(true);  
al.add(new Employee(…));  
al.add(“hello”);  
With generics// it was introduced in Java 5  
List<Integer> al = new ArrayList<Integer>();  
al.add(5);  
al.add(8);  
al.add(“hello”); // compilation error  
al.add(44.5); // compilation error

Note: You must use only classes in generics you can’t use primitive data types

List<int> al = new ArrayList<int>(); // wrong  
List<Double> al = new ArrayList<Double>(); // correct  
List<Employee> al = new ArrayList<Employee>(); // correct

Iterator: It is an interface used to iterate the collection, it has 3 methods

1. hasNext: checks next element is present if present returns true else false
2. next: returns the next element
3. remove: removes the iterated element

Collection has iterator() method which you must call to get the Iterator reference  
Iterator<Integer> itr = al.iterator();  
while(itr.hasNext()) {   
 int ele = itr.next();  
 if(ele == 5) { itr.remove(); // removes the element 5 }  
}

Example  
List<Integer> al = new ArrayList<Integer>();

al.add(50); al.add(20); al.add(30); al.add(5); al.add(40); al.add(5); al.add(20); al.add(5);

al [50, 20, 30, 5, 40, 5, 20, 5]

al.remove(5); // remove the element present in 5th index

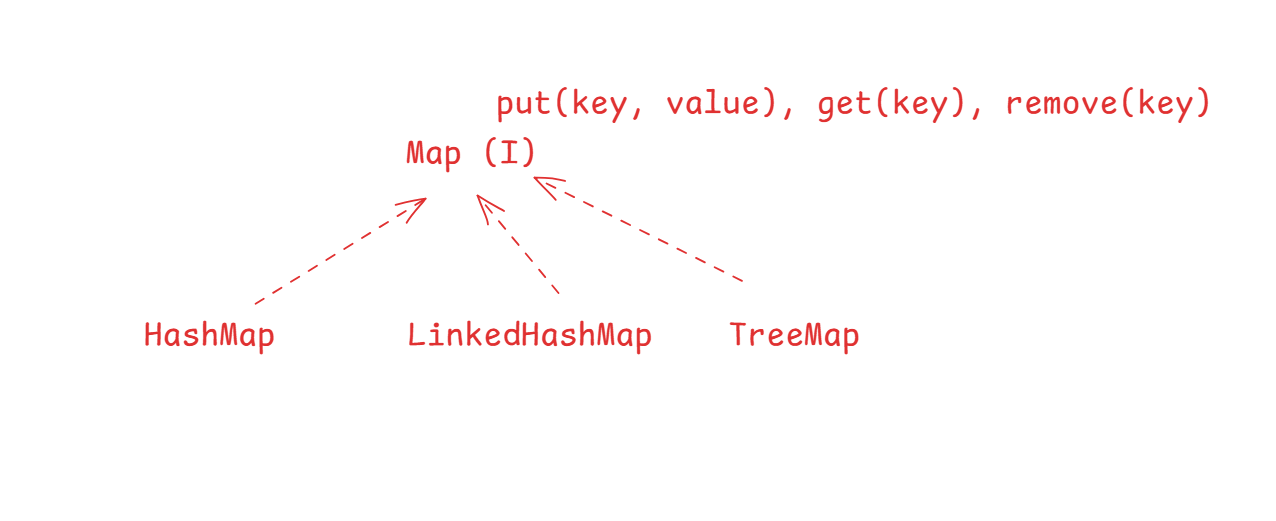
al.remove(Integer.valueOf(5)); // removes the value 5

Iterator<Integer> itr = al.iterator();

v = 5

itr.hasNext() -> it.next() == 5 -> itr.remove()

Map: It is also a datastructure where it maintains the data in key & value pairs, it is not part of collection hierarchy but it is also dynamic in nature.

Map<Key, Value>: it doesn’t support duplicates, key must be unique, value can have duplicate, it has methods like

* put: stores the data
* get: to read the data based on key
* remove: to remove the data based on key

HashMap: maintains random order

LinkedHasMap: maintains sequential order

TreeMap: maintains the key in sorted order

Note: Map & their implementations are present in java.util package.

Map<Integer, String> map = new HashMap<Integer, String>();  
map.put(123, “Raj”); map.put(456, “Vijay”); map.put(345, “Arun”);  
S.o.p(map.get(123));  
S.o.p(map)  
map.remove(123);  
S.o.p(map);   
change HashMap to TreeMap & LinkedHashMap & observe the output

You can maintains database credentials or server informations in the map in key & value structure

map.put(“dbuser”, “admin”);  
map.put(“dbpwd”, “Welcome@123”);

Java 8 features

1. Functional interface or Functional programming
2. Lambda expression
3. New Date & Time classes
4. Default & Static methods in interface

Activity

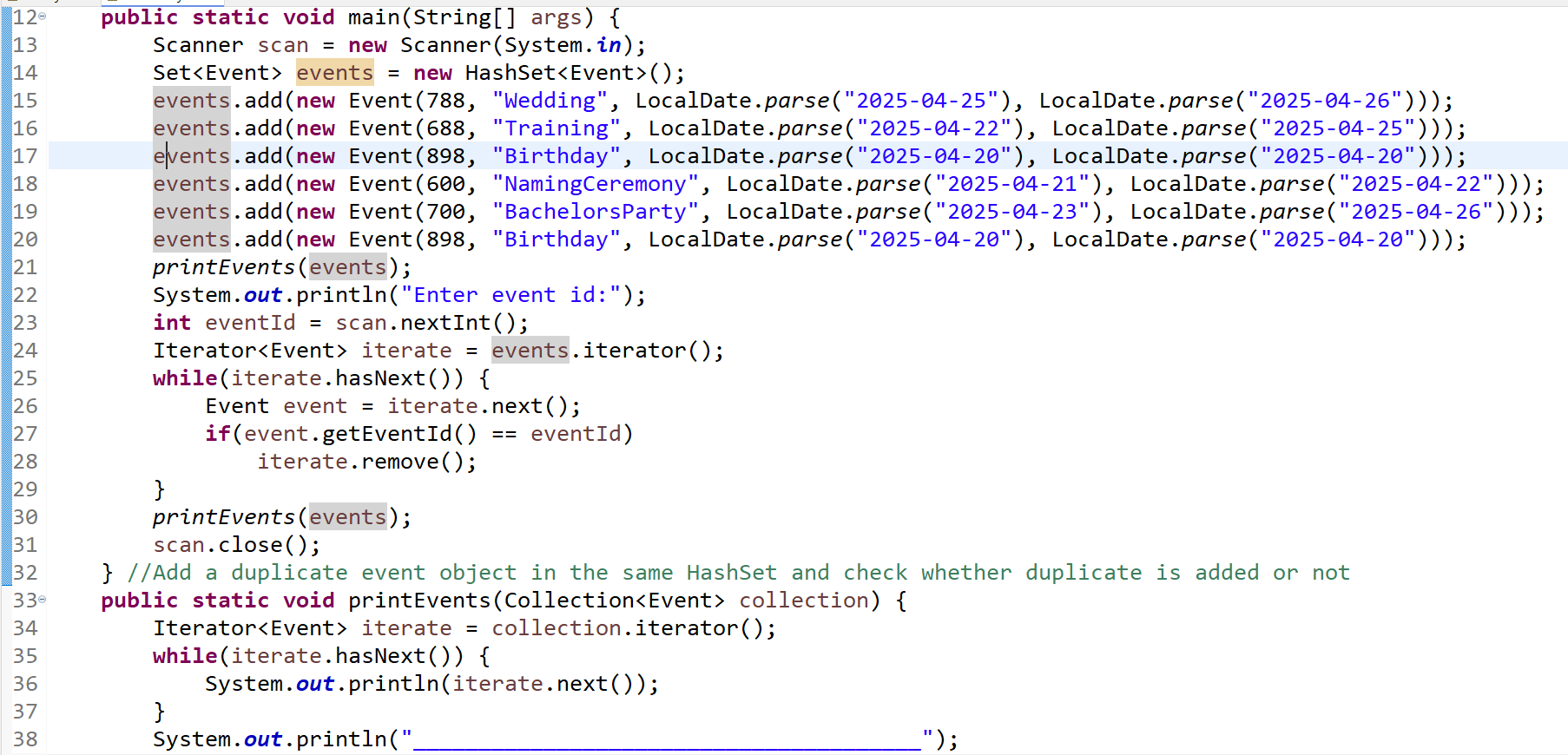
Create a class Event with following properties like eventId, eventName, startDate, endDate, constructor to initialize all the four properties, toString method to return all the properties, getters, setters for all the properties, in a separate class create the main method add 5 Event objects to the HashSet and print each event object by iterating the HashSet, next ask user to enter an event id and remove the event object from the HashSet which matches to the eventId, then again print the event objects present in the HashSet.

Add a duplicate event object in the same HashSet and check whether duplicate is added or not

Event.java

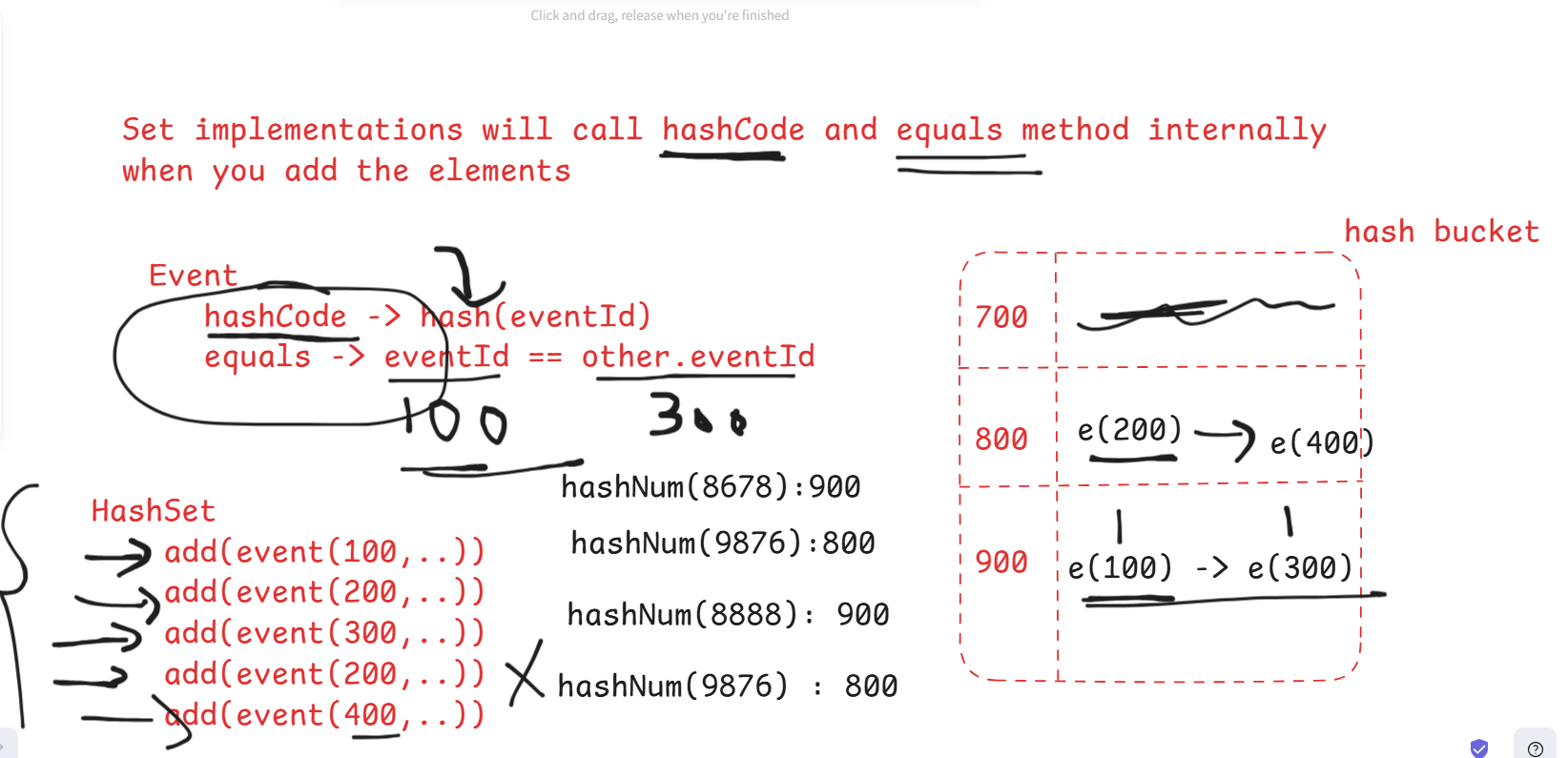


TestEvent.java



Whenever you add complex elements into the Set you must override 2 methods of Object class which are

1. equals(): comparing the objects whether they are equal or not
2. hashCode(): specifies where the object must be stored in the hash bucket



Sorting the event objects

You can add event objects into the TreeSet to keep in the sorting order, however TreeSet looks for Comparable or Comparator type to sort the objects, if they are not used then TreeSet throws ClassCastException.

Note: Simple types, String, LocalDate and few other classes are of Comparable type hence TreeSet can sort them, however custom classes not implementing Comparable can’t be sorted

How TreeSet can arrange the even objects using compareTo method.  
555, 666, 777, 888

event(777)  
event(666)  
event(888)  
event(555)  
event(444)

777-> compareTo -> compare(x, y) -> 0 -> 777(pivot)  
666 -> compareTo-> compare(666, 777) -> -1  
888 -> compareTo-> compare(888, 777) -> 1  
555-> compareTo-> compare(555, 777|666) -> -1

Comparable can be used for natural sorting, i.e., like a default sorting for complex type, you can use sorting id’s in ascending or as the default sorting technique, however when you need other properties to be sorted like name, startDate, endDate then you must use Comparator interface, which needs to be implemented outside the class that needs to sorted.

Comparator has one abstract method int compare(x, y)

You can implement Comparator using a class or nested class or anonymous inner class

Comparator<T> c1 = new Comparator<T>() {   
 public int compare(x, y) { return … }  
}  
You must pass this comparator object to the TreeSet(Comparator)  
Set<T> set = new TreeSet<T>(c1); // TreeSet uses Comparator to compare the object  
Set<T> set = new TreeSet<T>(); // TreeSet uses Comparable to compare the object

Functional interface are those interface which will have only one abstract method

ex: Comparator, Runnable,

You can use lambda expression to simplify writing the implementations to these functional interface

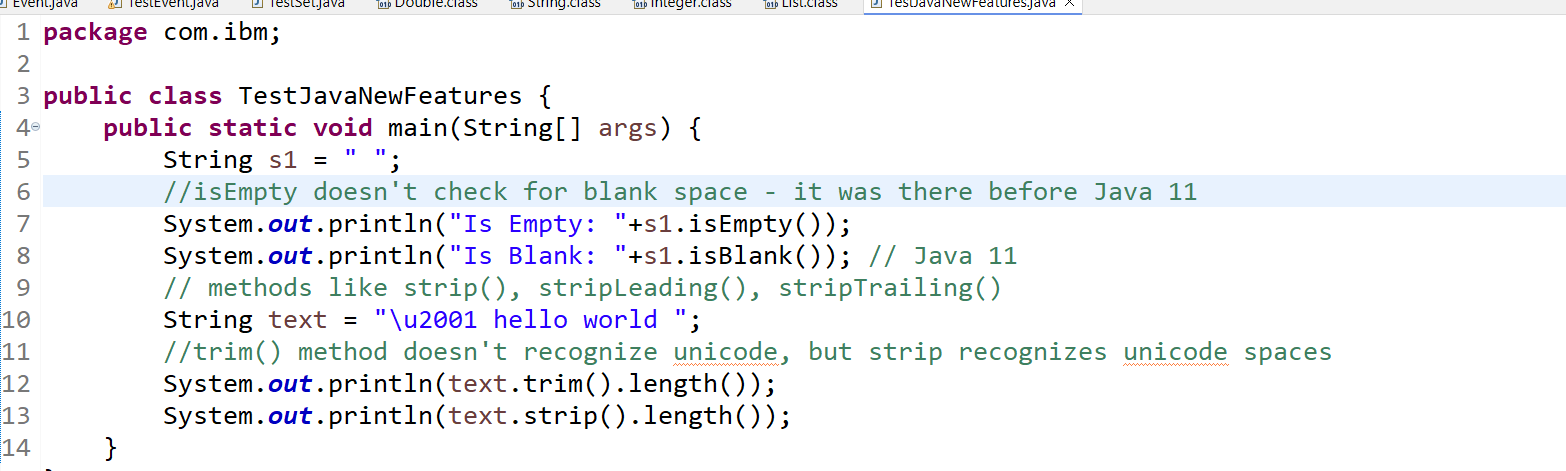
|  |  |
| --- | --- |
| Implementation of Functional interface | Lambda Expression |
| Comparator<T> cmp = new Comparator<T>() {   public int compare(T x, T y) {   return value   } } Set<T> s = new TreeSet<T>(cmp); | Comparator<T> cmp = (x, y) -> value;  Set<T> s = new TreeSet<T>(cmp)  Or Set<T> s = new TreeSet<T> ( (x, y) -> value)) |

Java 8 features

* LocalDate, LocalTime, LocalDateTime
* Functional interface & Lambda expressions
* static & default methods in interface
* Method reference
* Stream APIs

Java 11 features

* Few utility methods int the String class – isBlank, strip, stripLeading(), stripTrailing()
* HttpClient – access remote service to send request & handle response

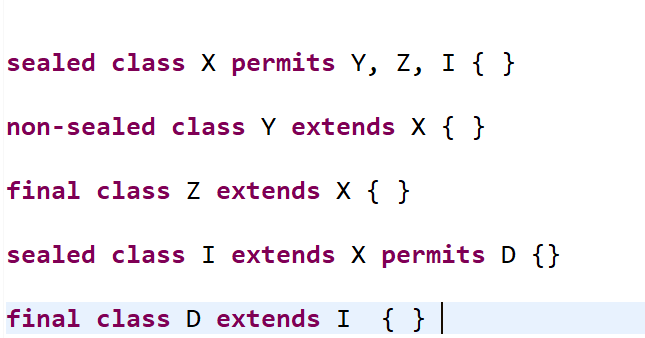


Java 17 features

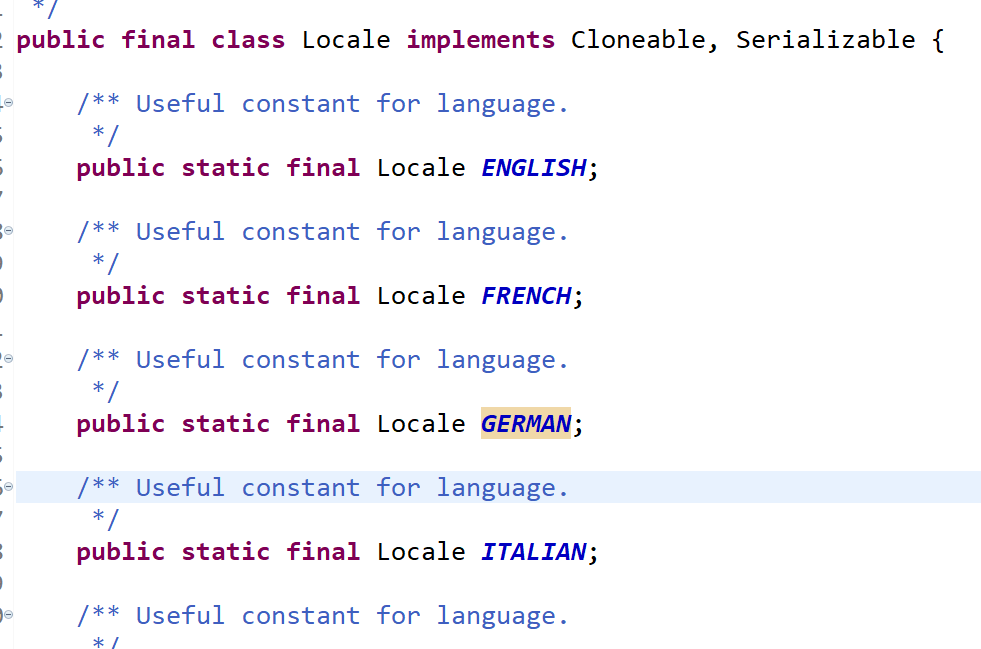
Sealed & Non-Sealed classes to have more control over inheritance to specify who can inherit which class, sealed class tells who all are permitted to extend, the subclass of sealed class must be either non-sealed or final or sealed

non-sealed will provide an option for any class to extend, final class can’t be extended

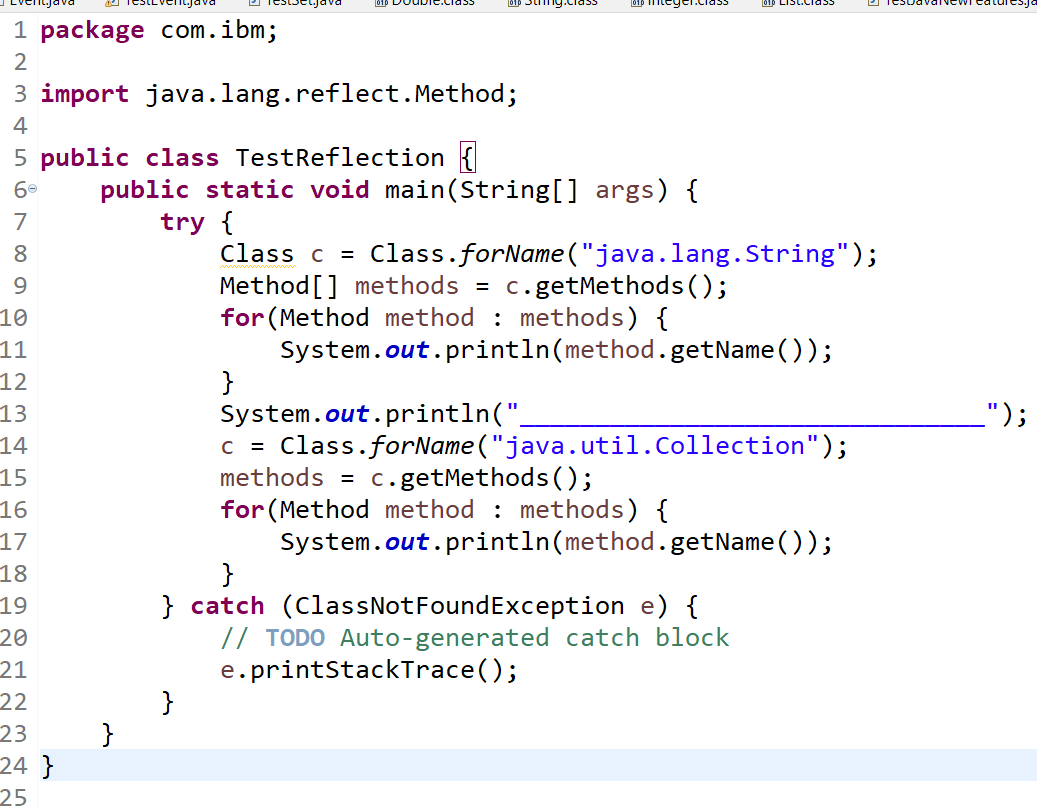
class A { } // any class can extend  
sealed class A permits B, C { } // only B & C  
non-sealed class B { }   
final class C { }



Internationalization

Adapting your application texts to display in various languages, there’s a class called Locale to implement Internationalization which provides various language for you   
ex:   


Reflection API: It is to analyze the classes to identify its members like methods, variables, constructors  
Suppose you want to see what all the methods present in String class, then you can use Reflection on String class.  
Class c = Class.forName(“java.lang.String”);  
c.getMethods(); // it gives all the methods of String class  
c.getConstructors(); // it gives all the constructors  
c.getFields(); // it gives all the fields



Serialization: To store the objects into the file, we can use few classes to serialize the object

1. ObjectOutputStream -> provides writeObject(Object) -> this can write the object to the file

ObjectOutputStream oos = new ObjectOutputStream(new FileOutputStream(“demo.txt”));

oos.writeObject( event );

class Event implements Serializable { }   
Serializable: It is an empty interface which is a marker interface that adds a type to the class, so at the time of serialization writeObject() checks if the object is of Serializable type, only then the object will be stored else an exception is thrown.

Deserialization: It is to read the serialized objecdt

1. ObjectInputStream ois = new ObjectInputStream(new FileInputStream(“demo.txt”))

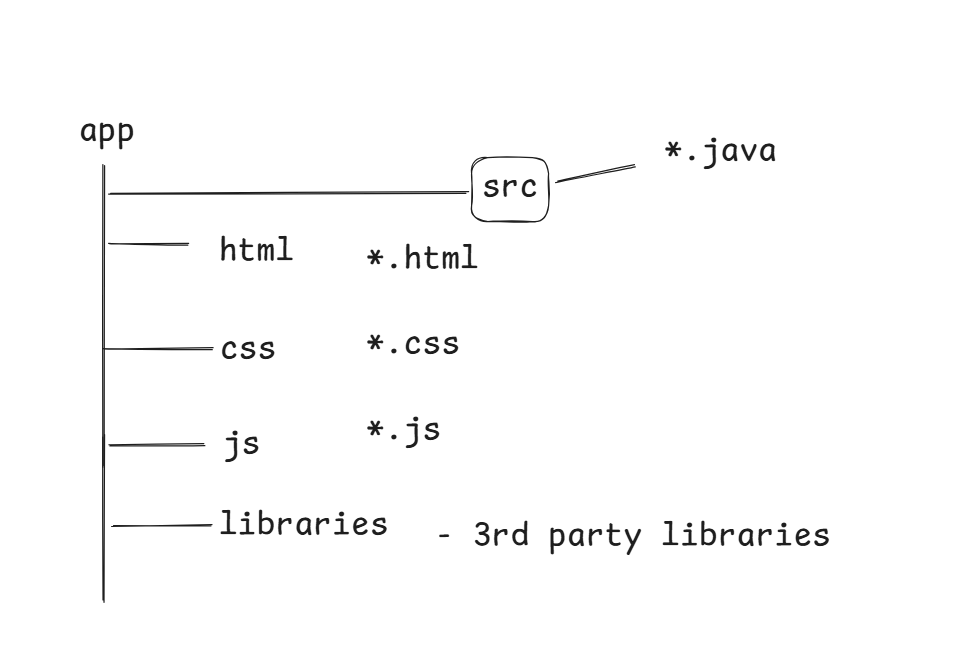
Event event = (Event) ois.readObject();

Debugging in java

In real time developers need to debug the application to understand the flow of the program, because debugging gives line by line information when the program gets executed.

HTML & CSS

Folder structure



HTML: it used to create websites that can display the content with inbuilt HTML elements (tags)

CSS: it used to style the HTML elements

Javascript: it adds interactivity to your website by dynamically manipulating HTML & CSS

Naming conventions

Name all the web resources like html, css, javascript in smaller case, create index.html which is usually treated as welcome file in all the applications, most of the servers treat index.html as a welcome file.

CSS types

1. inline stylesheet: each element will have a style

ex: <p style = “color:red;font-family:arial’>some content</p>

1. internal stylesheet: for the entire document you will have a style, all the elements will get those styles except the inline, because inline overrides internal

ex: <style> p { color : blue; font-size:’calibri’ } h2 { color : red }

1. external stylesheet: you can create a separate css file and link to multiple HTML

ex: to link <link rel=”stylesheet” type=”text/css” href=”css/styles.css”>

Types of selectors

1. tag selector: for a tag you will apply style
2. class selector: a tag with class attribute, it is used when you want multiple tags with same class to get a style
3. id selector: an HTML element will use id to uniquely identify itself, you can use id selector to apply style with id

<p class = “danger”>some content</p>  
<h2 class = “danger”>some content</p>  
<button class=”primary”>Button</p>  
<button class=”secondary”>Button2</p>  
.danger { color: red;}   
.primary { color : blue; }  
.secondary { color: black }

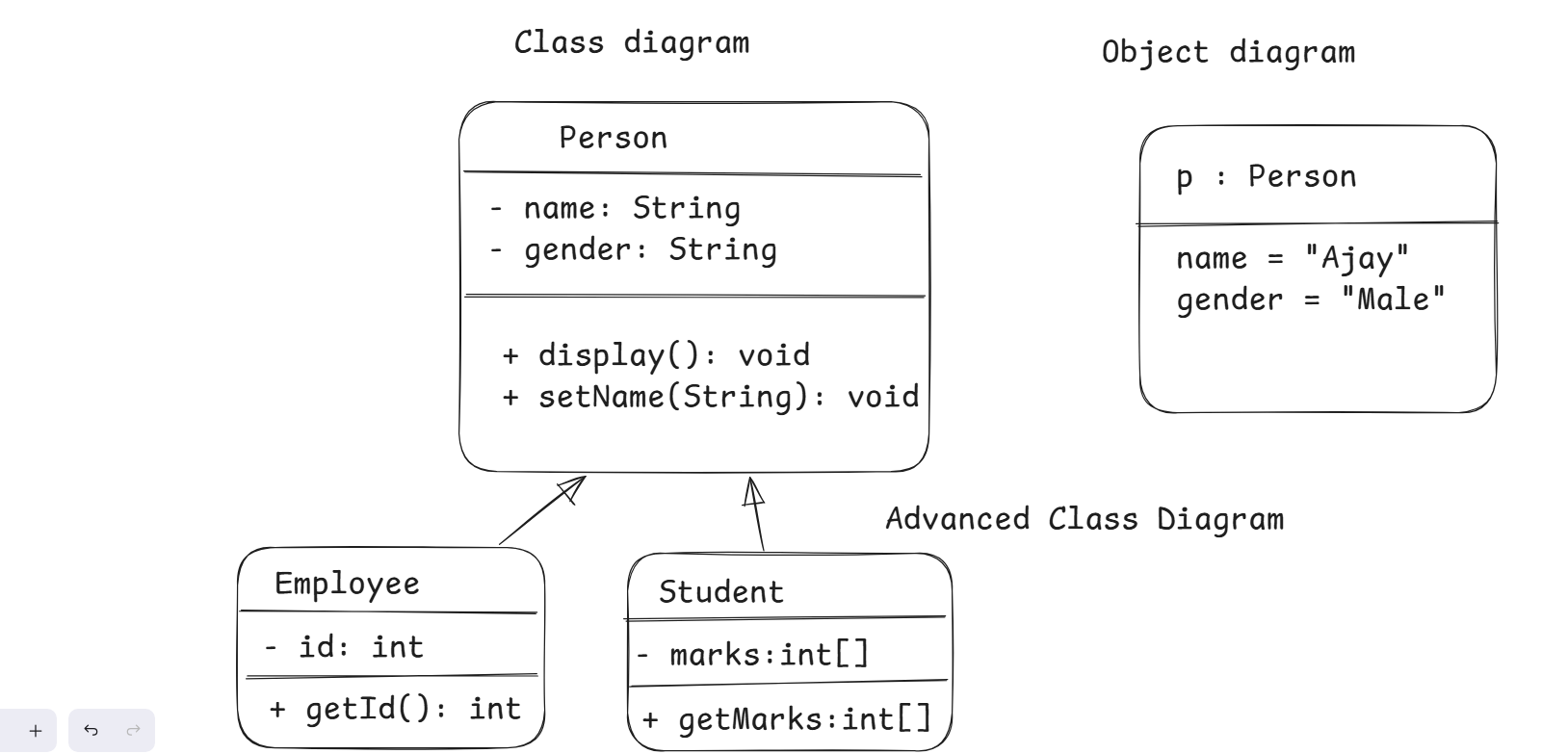
<p id = “p1”>some content<p>  
#p1 { color : orange }

UML

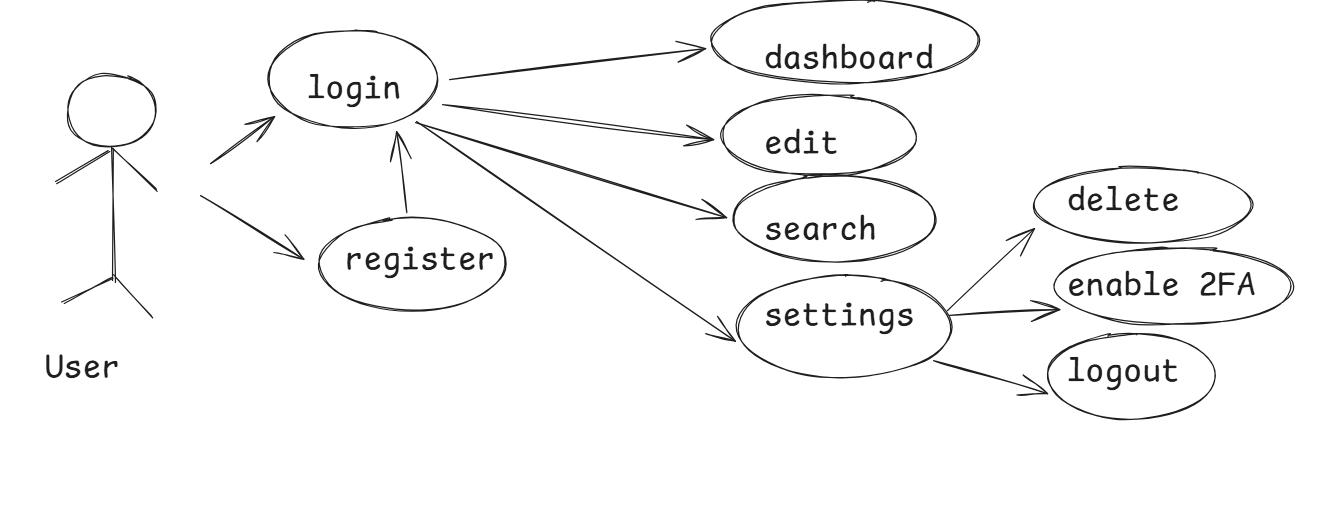
Unified Modeling Language, it is a graphical representation of the software system, it is done by the top management people like SME’s / Business analysts, it will have following diagrams like

1. Class diagram
2. Object diagram
3. Use case diagram
4. Interaction Sequence diagram
5. Interaction Communication diagram
6. Activity diagrams
7. State diagrams
8. Component diagrams

Class diagram & Object diagram



Use case diagram: It represents features of the application



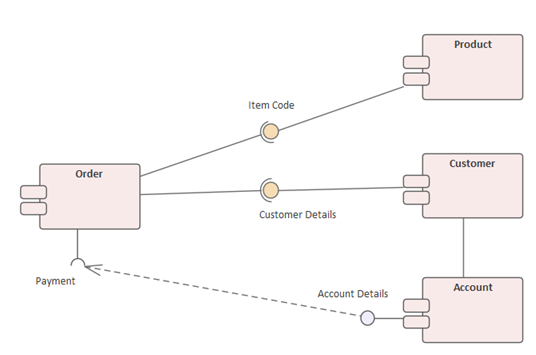
Interaction sequence diagram

interaction communication diagram

state diagram

activity diagram

component diagram: represents independent components and how they are connected to each other, i.e., an order object needs product, customer & account informations



Javascript:

It is a programming language for HTML & CSS, it can manipulate HTML & CSS at runtime like adding | updating | deleting | reading HTML and CSS.

Javascript supports lot of programming constructs like

* variables
* functions
* operators
* loops
* conditional statements
* classes, objects, arrays

How to create variables in Javascript

var name = “Ajay”;  
var age = 25;  
var salary = 35000.0;  
var isMarried = false;

You can use let & const keywords to create variables instead of var keyword, because var is global variable, it is accessible outside the function also, however let & const are blocked scoped,

How to create functions in Javascript

function display() {   
 // logics in display method  
 }  
function add(x, y) {   
 let z = x + y;  
}

How to create arrays in Javascript

let items = [ “apple”, “orange”, “mango” ] ;

How to iterate an array in Javascript

for(let item of items) {   
 console.log(item); //prints in browser console  
 [or]  
 document.write(item); // prints in browser body  
}  
For of: it is to iterate arrays

// traditional for loop  
for(let i = 0; i < items.length; i++) {   
 console.log(items[i]);  
}

For in: it is to iterate the objects

How to create objects in Javascript

let emp = { id : 100, name : “Ravi”, age : 39 }  
console.log(emp.id); // 100  
console.log(emp[id]); // 100  
console.log(emp[name]); // Ravi

for(let key in emp) {   
 console.log(emp[key]);  
}

How can javascript access HTML element

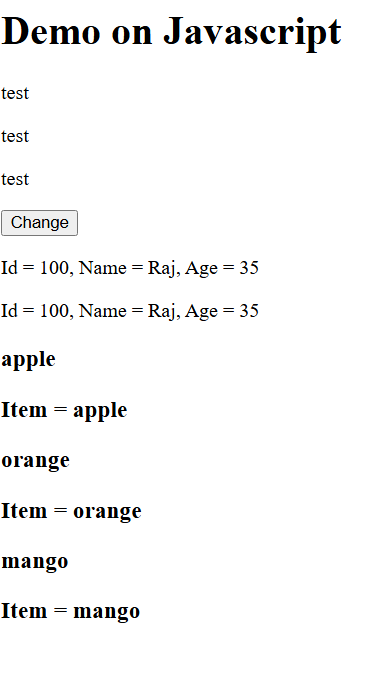
let ele = document.getElementById(“p1”); // returns an element having the id = “p1”  
let ele2 = document.getElementsByTagName(“p”); // array of <p> elements will be returned

ele.innerHTML = ‘some content’; // adds an HTML content to the element

let counter = 0;  
for(let x of ele2) {   
 x.innerHTML = counter++;  
}



Output



Node.js: It is a javascript runtime environment that can execute javascript in the backend without the need of browser, if you run javascript at the backend you could able to write programs that can access files, database, serve request to the clients

Node.js provides npm (Node Package Manager) which lets you install third party libraries that are written in javascript

Typescript: It is a super set of javascript, that adds types to the Javascript, so that the results of javascript will be predictable & the data will safe, developers can write the typescript and compile it using typescript compiler that generates the Javascript, then you can run the Javascript

npm install -g typescript: this command downloads the typescript compiler, here -g is a global installation, if you ignore -g then it installs in the current location where you are entering install

Basic Types in Typescript

string

boolean

number

any

Syntax:

let name : string; // you can only store string, if store other types you get error, in Javascript you don’t get error because it doesn’t recognize the types.

function greet(name : string) : void { // returns void   
}  
greet(20); // error

let userId : string | number; // userId can store string or number

userId = “user01”;  
userId = 12345;

Note: When you create a function without a class, then function keyword is mandatory, however when you create a function inside a class you must not use function keyword

class A {   
 test() { … } // it is understood it’s a function  
}

MongoDB: It is a NoSQL Database which doesn’t maintain the structure of the document, in MongoDB the data will be stored in JSON / Javascript object format which are called as documents

SQL vs NoSQL

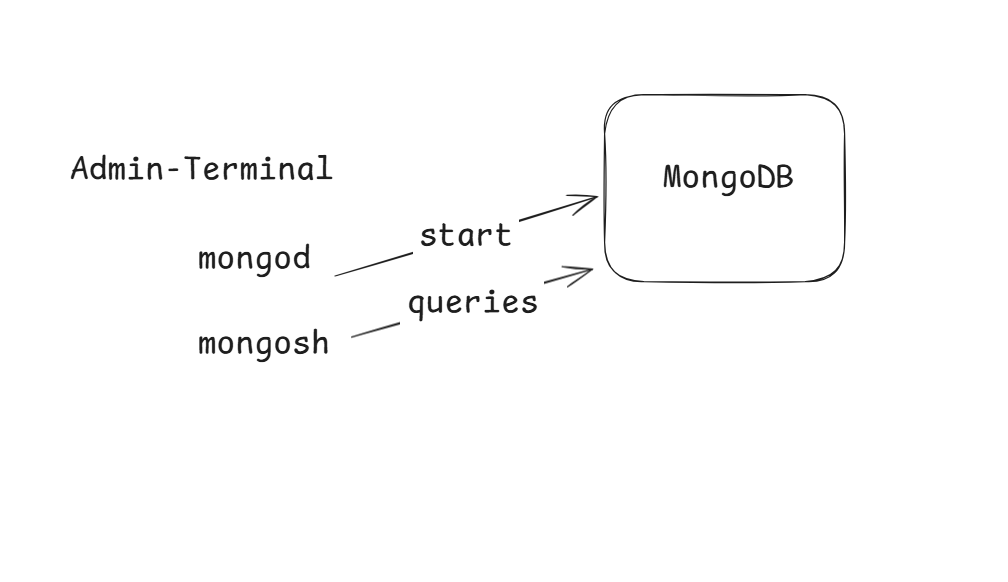
In SQL it is mandatory that every record in a table to be of same structure i.e., if a table has 4 columns then each record will have values for those 4 columns

In NoSQL each record can have different structure, it is useful when the records are dynamic

MongoDB setup

It stores all the data in a folder called data/db which you can create in your root directory/drive like C drive in Windows

Note: you must have this folder in your C drive only then you can start the MongoDB



mongosh you don’t get in the mongodb installation, you need to download a separate zip file mongodb tools

SQL & MongoDB terminologies

|  |  |
| --- | --- |
| SQL Terminology | NoSQL Terminology |
| Database | Database |
| Table | Collection |
| Records | Documents |
| Columns or Attributes | Attributes or Keys in the document |
| Primary Key column can have any name | Primary key column must be \_id |
| SQL queries | Inbuilt Javascript functions |
| Parent & Table are linked with foreign key | No concept of foreign key, but you can nest the child documents |
| Oracle, MySQL, Derby, DB2 they all use SQL which are RDBMS | MongoDB use NoSQL |

Note: MongoDB uses Javascript function hence it is case sensitive

How to create a collection

db.createCollection(“employee”); // employee collection will be created  
To perform CRUD operation you have inbuilt methods like insertOne, insertMany, deleteOne, deleteMany, updateOne, updateMany, findOne, find and so on, all these methods you need call from the collection name

How to store one or more documents in a collection  
db.employee.insertOne({\_id: 123, name : “Atharva”, date: new ISODate(“2024-04-08”)});  
db.employee.insertMany([ {\_id : 456, name : “Ravi”, date: new ISODate(“2000-06-16”) }, { ……. }, {….. } ]);  
How to read all the documents

db.employee.find(); // get all the documents  
How to read a single document: You use \_id since it is unique  
db.employee.find({\_id:123}); // returns a document that has \_id = 123

db.employee.find({name : ”Raj”});// returns one more documents having name = Raj

How to update the document

db.employee.updateOne({\_id:123}, {$set:{name:”Rajesh”}});

How to update one or more documents

db.employee.updateMany({name:”Raj”}, {$set:{name:”Rajesh”}});

How to delete the documents

db.employee.deleteOne({\_id:1});  
db.employee.deleteMany({name:”Raj”}); // documents whose name is Raj will be deleted  
db.employee.deleteMany({}); // all the documents will be deleted

Try from the official document these operators

$or, $and, $eq, $ge, $le, $like, $match, $group, $sort, $sum

SQL: Structure Query Language, it is the language RDBMS use, there are 5 types of SQL commands

1. DML – insert, update & delete
2. DDL – create, alter, truncate, drop
3. DRL – select
4. TCL – commit, rollback, savepoint
5. DCL – grant & revoke

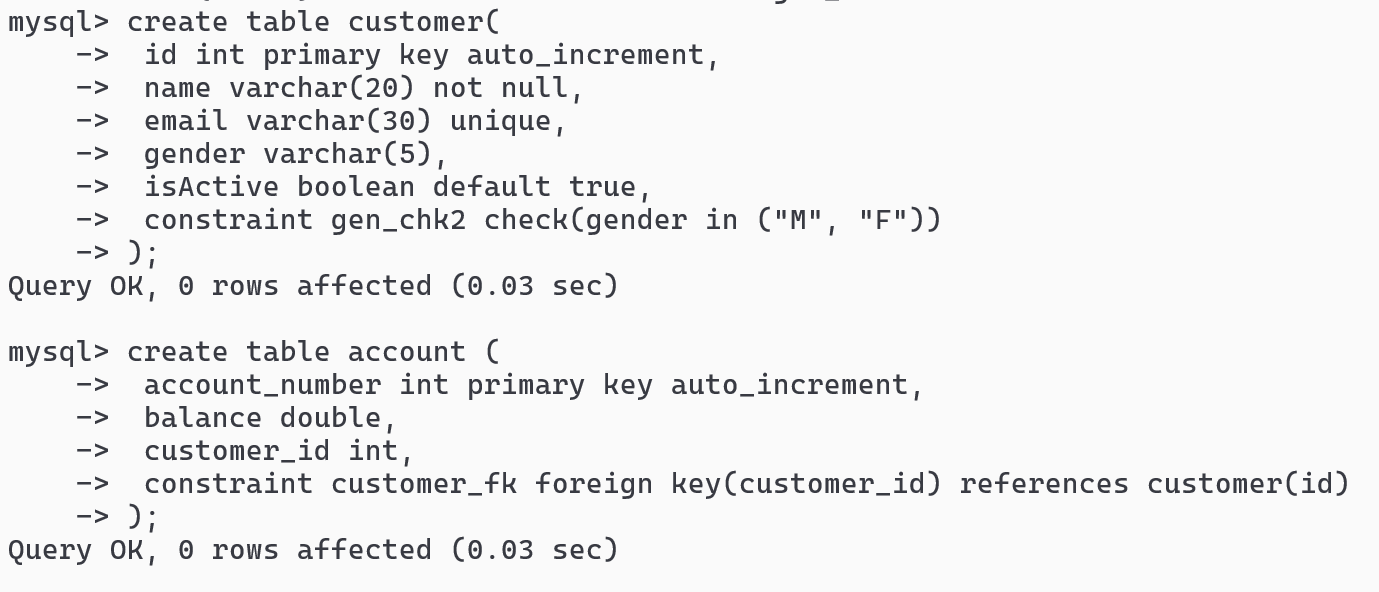
Datatypes:

1. int
2. varchar
3. date
4. bigint
5. double
6. boolean
7. datetime
8. float

Constraints: These are rules you can apply on a table or a column

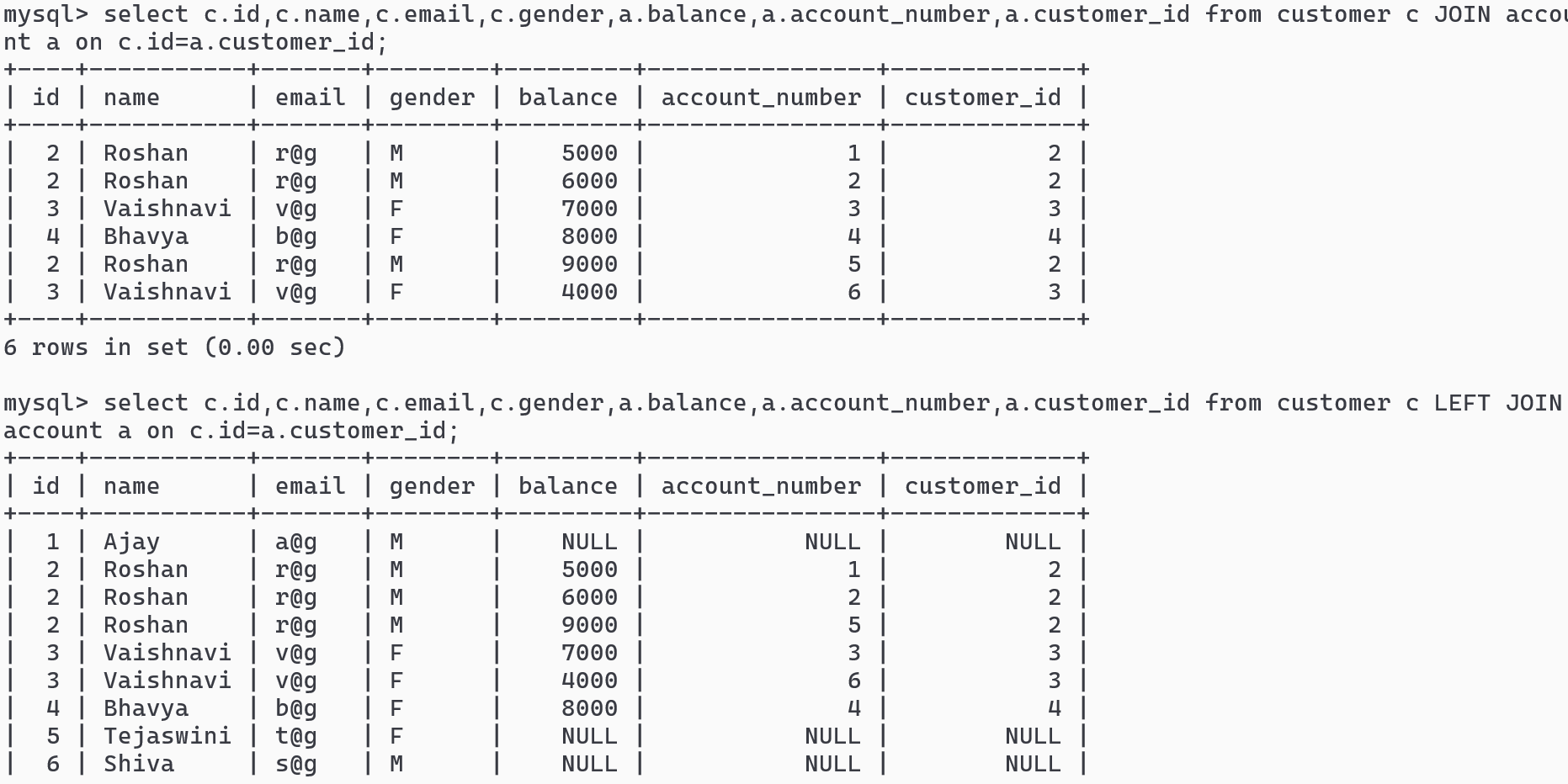
1. primary key: uniquely identifies the record, doesn’t support null
2. unique: supports unique but also supports null
3. not null: no null is allowed
4. check: to have conditions on the value like age <= 60 & age >= 18, gender must be either male or female
5. foreign key: linking child table with the parent table, customer table linking with account table, then student table linking with marks table, employee with department table
6. default: its value is considered when no value is provided

ex: profile table status ‘isActive’ by default



Types of JOIN

1. Inner JOIN: only matching records
2. Left JOIN: all the records from the left table & right table will have only matching records
3. Right JOIN: all the records of right table & left table will have only matching records
4. Full JOIN: all the records of right & left table is displayed even if they don’t match



Inbuilt SQL functions

1. Single row function – each record will have separate result – upper, lower, to\_char, concat, trunc, round and so on.
2. Aggregate function – single result for multiple records – avg, sum, min, count, max,

JDBC: It is an API that stands for Java Database Connectivity to allow java programs to interact with RDBMS like MySQL, DB2, Oracle and etc.

JDBC uses JDBC drivers which are java programs to connect to the specific database, these drivers are provided by database vendors

Steps to follow to interact with database, there are totally 5 steps

1. Loading the driver: Class.forName(“com.mysql.cj.jdbc.Driver”); // MySQL Driver

Loading the driver is optional from Java 8 onwards, because from Java 8 it automatically loads the driver based on the URL

1. Establishing the connection: Connection con = DriverManager.getConnection(url, username, password);

url = jdbc:mysql://localhost:3306/ibm\_db

username = root

password = root

1. Creating the Statement: Statement stmt = con.createStatement();
2. Execute Statements

int c = stmt.executeUpdate(“insert into employee values….”);

// update & delete queries can also be passed, the int represents the number of rows affected

ResultSet result = stmt.executeQuery(“select \* from employee”);

// result stores the select result, you need to navigate over the result using the getters methods

while(result.next()) {   
 int id = result.getInt(“id”); String name = result.getString(“name”);   
 LocalDate dob = result.getDate(“dob”).toLocalDate();

Employee emp = new Employee(id, name, dob);  
//use some collection and store the emp  
 list.add(emp); // List<Employee> list = new ArrayList<>(); created before while()  
}

1. Closing the resources (optional if you use try with resource)

rs.close(); stmt.close(); con.close();

Statement comes with 3 types

1. Statement: Better when queries are changing
2. PreparedStatement extends Statement: Better for dynamic queries
3. CallableStatement extends PreparedStatement: Used to invoked stored procedures which are programs stored in the database, these are called as PL/SQL

Statement vs PreparedStatement

Statement object queries are always parsed, compiled and executed in the database on each execution  
Statement stmt = con.createStatement();  
int c = stmt.executeUpdate(“insert into employee(name, dob) values(“+input1+”,”+input2+”)”);

ResultSet rs = stmt.executeQuery(“select \* from employee where id = “+input3);

PeparedStatement object queries are pre-compiled, they are parsed & compiled only once & stored in the database cache memory and on each execution only the values are replaced and directly executed

PreparedStatement pstmt = con.prepareStatement(“insert into employee(name, dob) values(?, ?));  
pstmt.setString(1, input1); pstmt.setDate(2, input2);  
int c = pstmt.executeUpdate();  
PreparedStatement pstmt = con.prepareStatement(“select \* from employee where id = ?”);  
pstmt.setInt(1, input3);  
ResultSet result = pstmt.executeQuery();

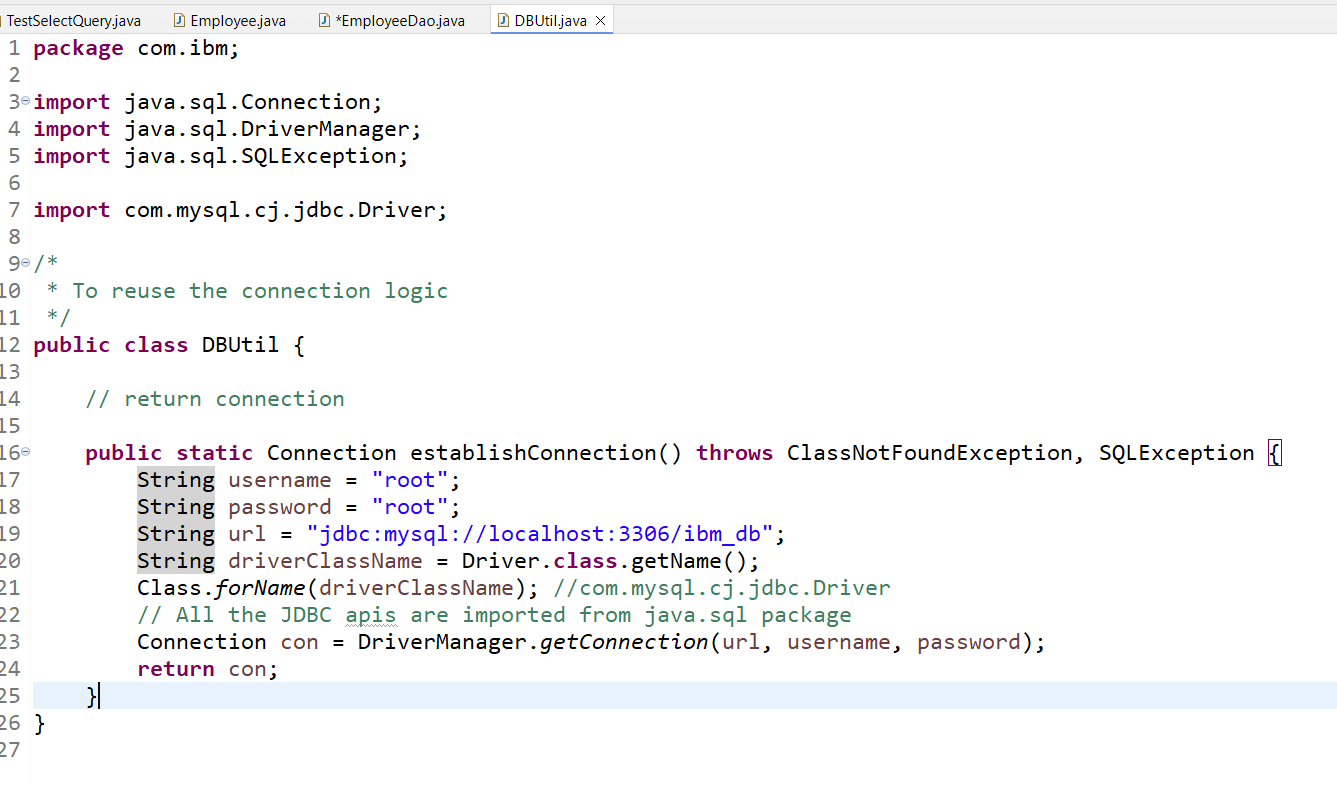
try with modern syntax eliminates 5th step

try (  
 Connection con = DriverManager.getConnection(url, username, password);  
 PreparedStatement pstmt = con.prepareStatement(query);  
) {   
 // set values to the ?  
 try (ResultSet rs = pstmt.executeQuery) { ……………….. }   
 or   
 int c = pstmt.executeUpdate();  
}

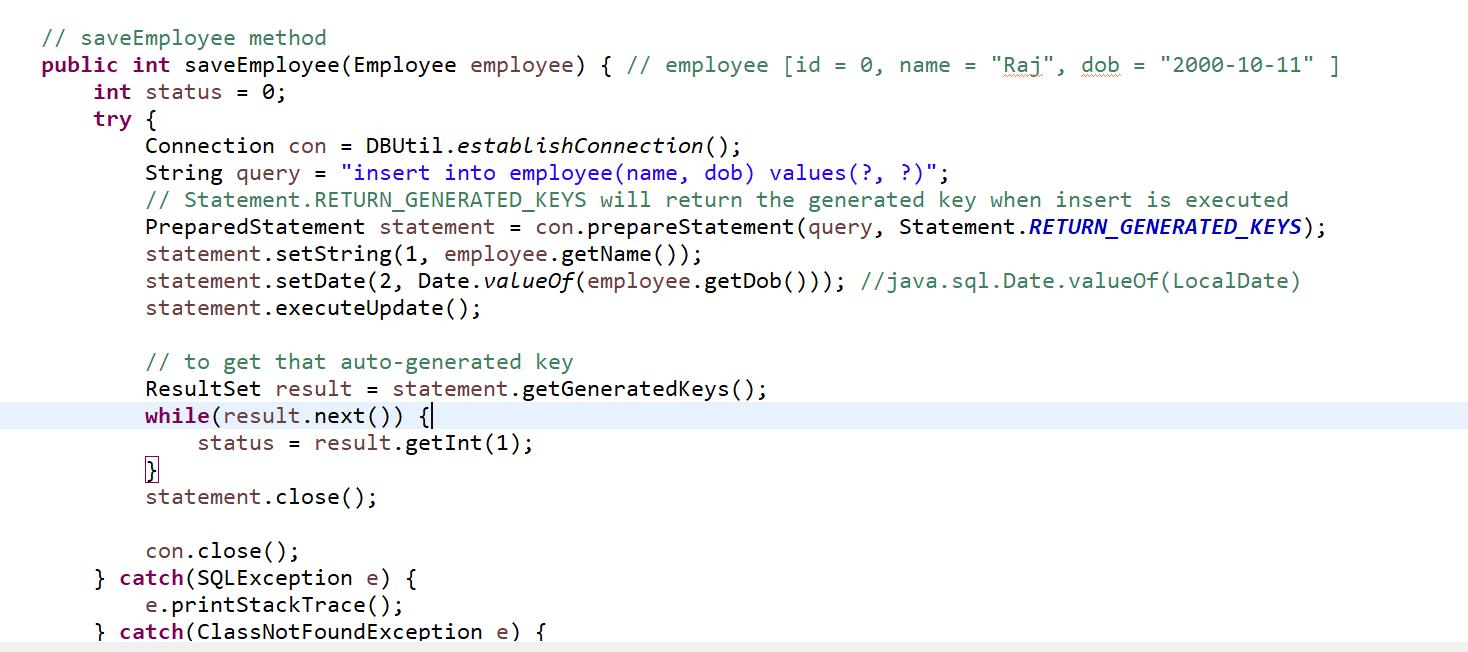
To store you can create a int saveEmployee(Employee employee) { }

main method will pass employee object to the saveEmployee() and saveEmployee() must insert name & dob

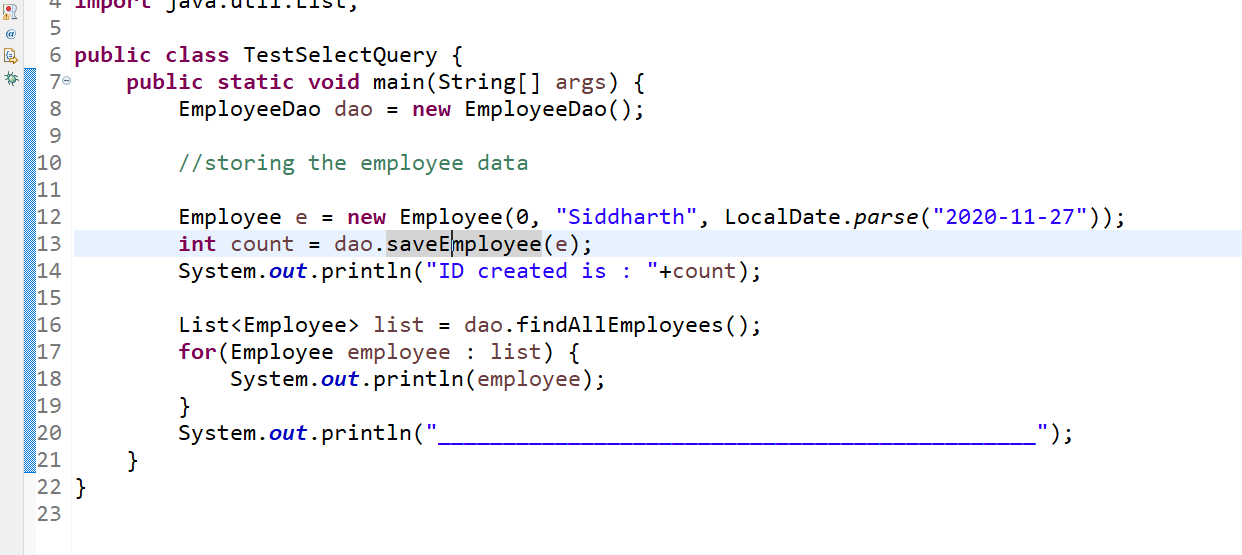
DBUtil.java takes care of having a reusable connection



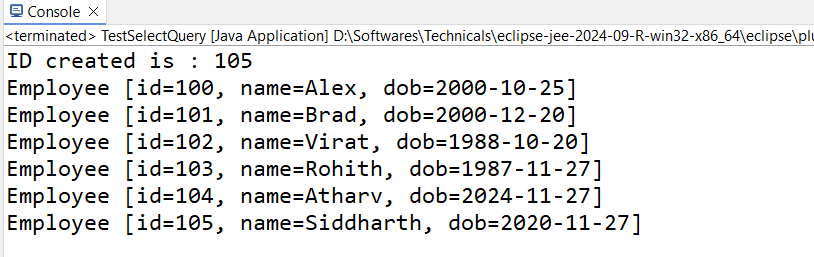
Storing the data with getting the auto-generated value



main method



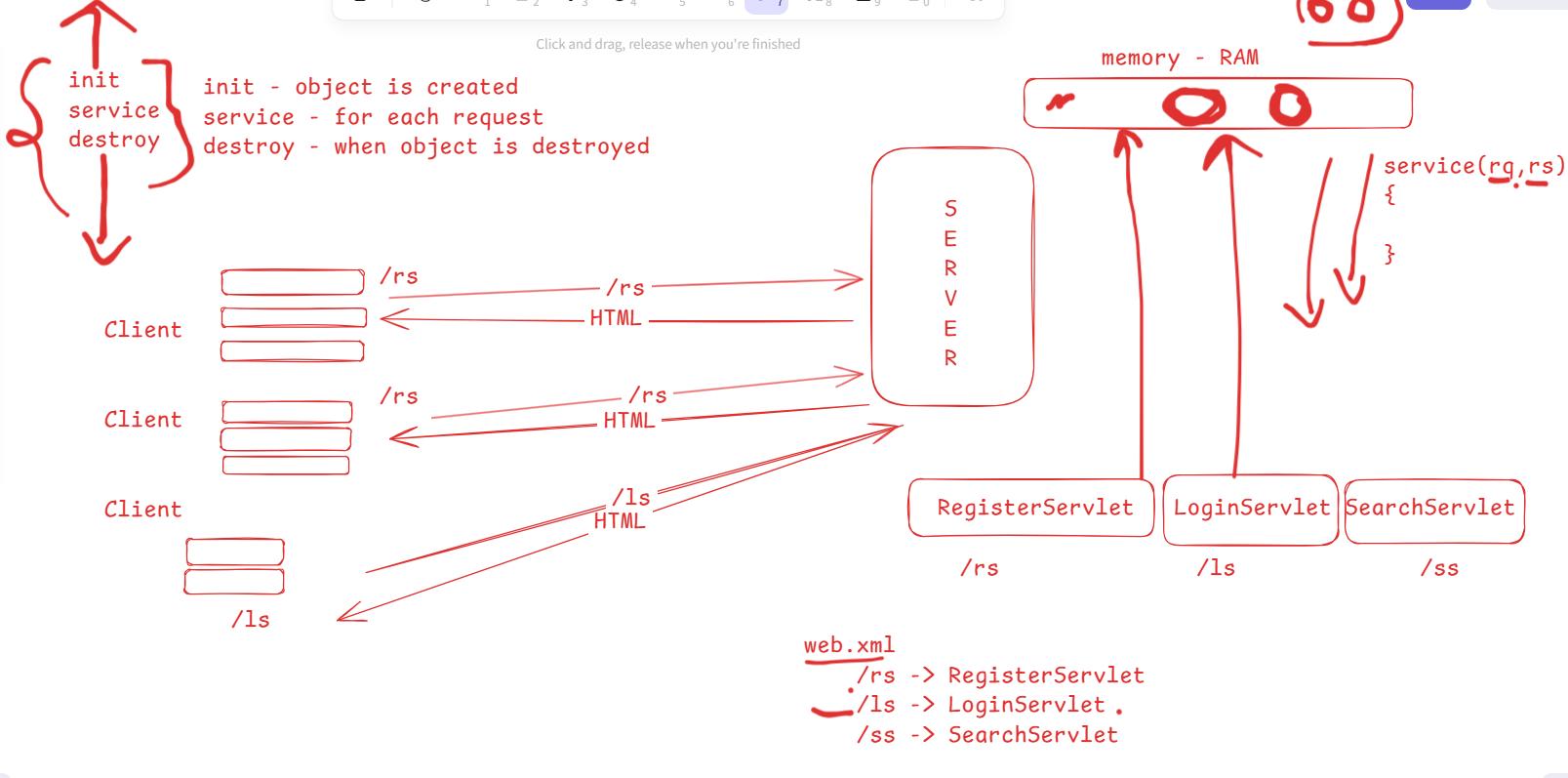
Output:



Servlets & JSP

Servlets & JSP are used to develop web applications using Java, both are used to create dynamic web applications, but Servlet came first to address the limitation in the servlet JSP was released.

Servlets are java programs that are executed at the server side to create dynamic web page, it handles client request & generate the response in HTML format.



web.xml is called as deployment descriptor it will have URL mapping, welcome file lists

From Servlet 3.0 on wards URL mapping can be done with annotations

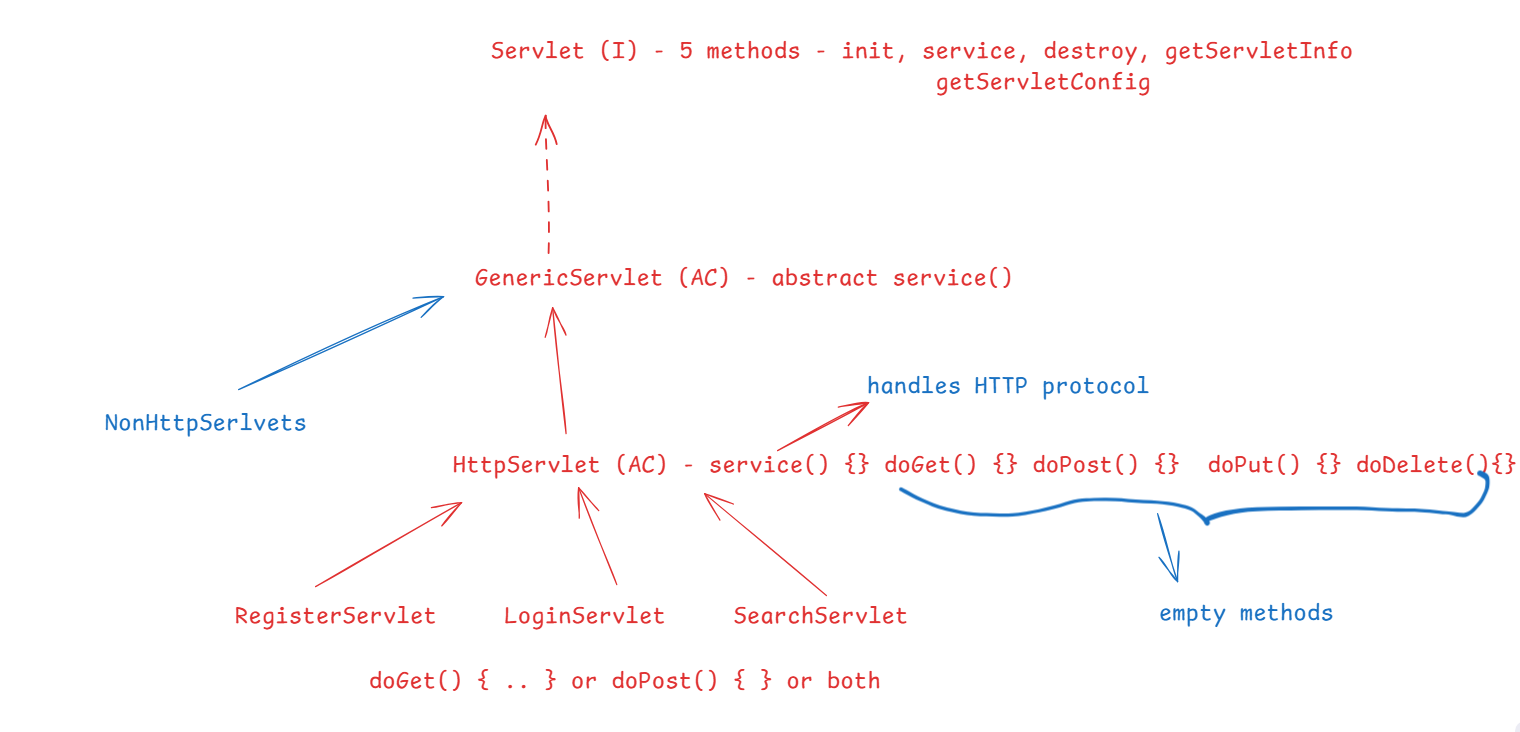
There are 3 life cycle methods in Servlet

1. init - initialization logic
2. service - handling the protocol(FTP, SMTP, HTTP), handling the requests & generating the response
3. destroy - clean up operations

Java came up with HttpServlet which handles HTTP protocol in the service() method of the Servlet, so you can create the servlet by extending HttpServlet so that every request using HTTP protocol will be handled automatically, hence you must extend HttpServlet & override doGet(), doPost() methods provided by HttpServlet, which are called by the HttpServlet.service() method based on the type of request

If client sends GET request via URL(data inside URL) -> then doGet will be called  
If client sends POST(data inside request body) request -> then doPost will be called

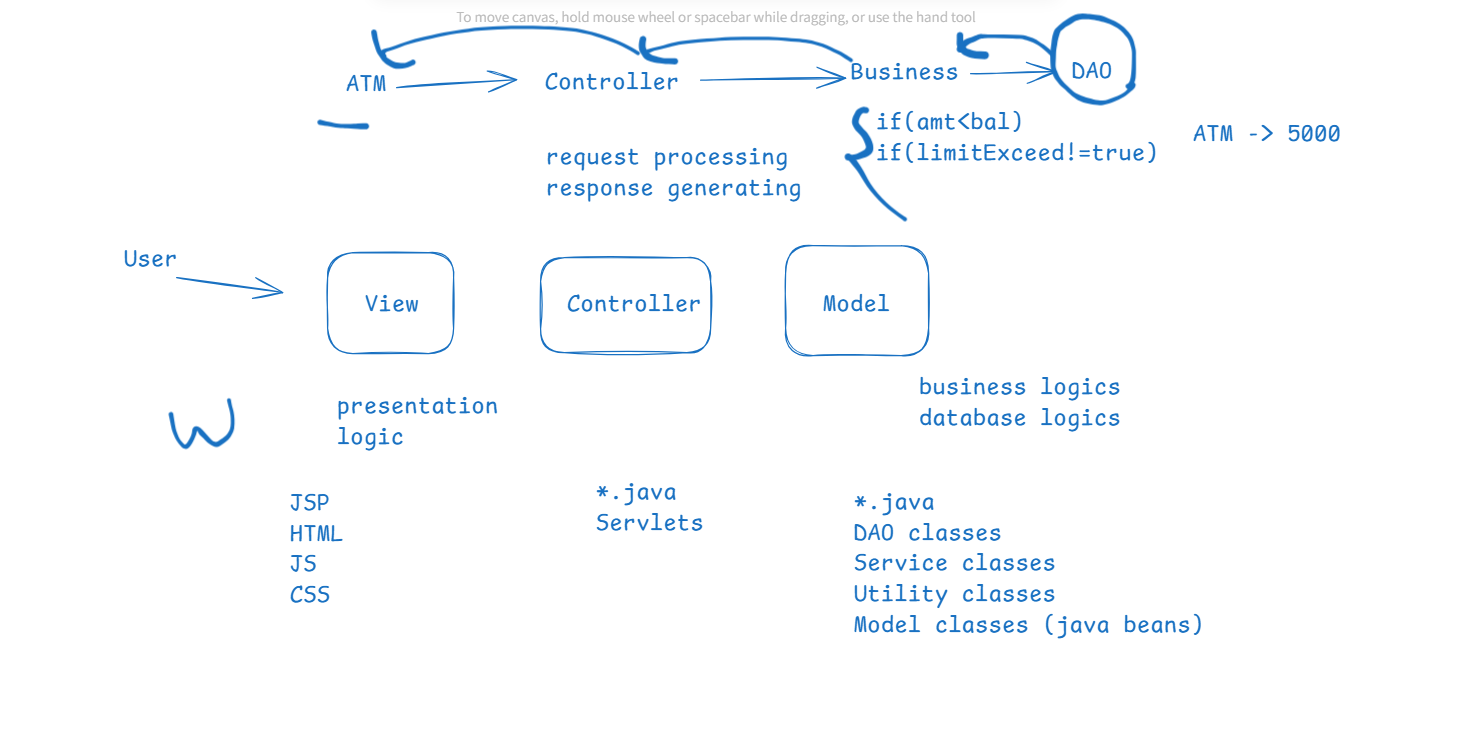
Servlet Hierarchy



Limitations of Servlet

Servlet embeds HTML code within the Java code & its complex to design the UI, but its dynamic, however to design the dynamic UI java introduced JSP which you can use to create dynamic web pages because its syntax is like HTML, but you can’t ignore servlet because it can have java code & do more job than the JSP

In MVC architecture   
Servlets take Controller part  
JSP take View part  
DAO takes Model part



JSP (Java Server Pages)

It has 5 building blocks

1. Directive elements
2. Scripting elements
3. Expression elements
4. Inbuilt objects
5. Action elements

Directive elements: They start with <%@ and end with %>, there are 3 directive elements

1. <%@page
2. <%@include
3. <%@taglib

Directive elements give instructions to the server like importing a java package, including a file, including some external tag library

<%@page import=”java.time.LocalDate” %>  
<%@include file = “abc.txt” %>  
<%@taglib uri = “externalURL” prefix=”aliasName” %>

Scripting elements

1. scriptlet <% %>: The code you write inside scriptlet is executed for each request
2. declarative <%! %>: Here you can declare variables, its like declaring variables inside the class

Expression <%= %>: it is used to print the java variables or expressions

Inbuilt objects: These are inbuilt variables which you can use in JSP page

1. request
2. out
3. session
4. response

ex:  
<%  
 String name = request.getParameter(“username”);  
 out.println(“<h2>Hello “+name+”</h2>”);  
%>

Inter servlet communication

This is like how two servlets can communicate, where one servlet sends request to another servlet and uses the response of the second servlet

Note: a servlet can send request to JSP also

RequestDispatcher is used to dispatch the request from a servlet to another servlet/jsp/html

RequestDispatcher is an interface with 2 methods

1. forward(request, response)
2. include(request, response)

How to create request dispatcher

RequestDispatcher rd1 = request.getRequestDispatcher(“default.jsp”); [or]  
RequestDispatcher rd2 = request.getRequestDispatcher(“/SomeServlet”); [or] .html

rd1.forward(request, response) or rd1.include(request, response)

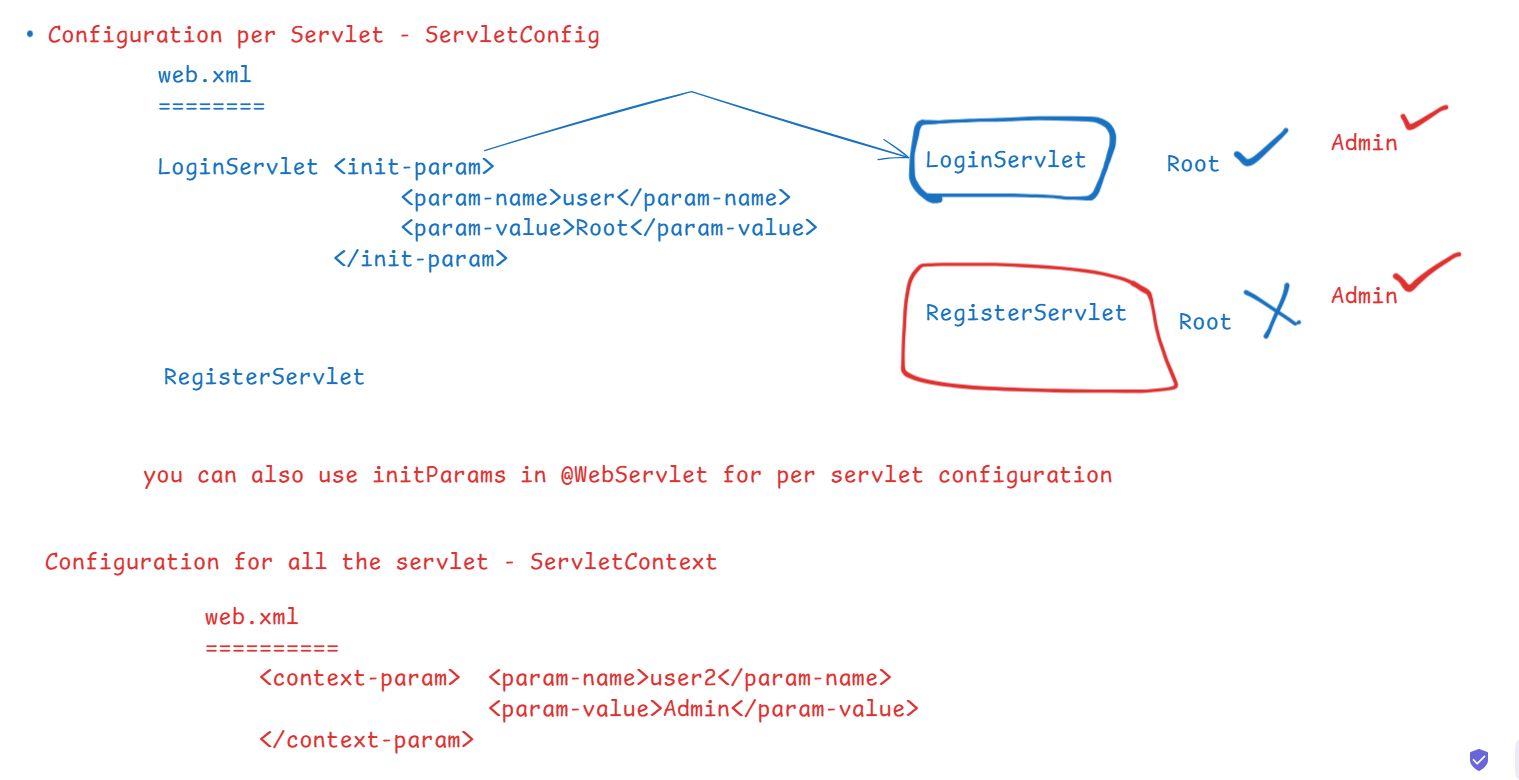
forward: shows the destination resource page and ignores the source page  
include: shows both source & destination content

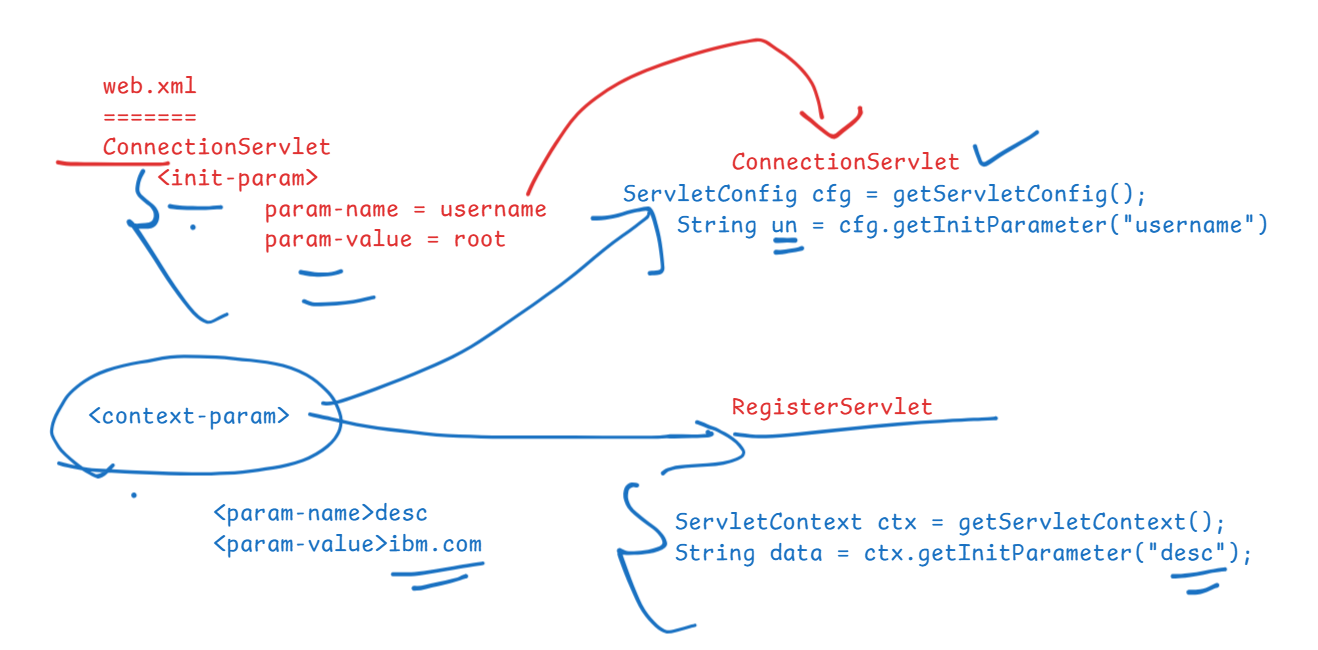
Is it possible to load the servlets or pre-initialize before the first request

Yes, you must use load on start up property in the servlet

Annotation based  
@WebServlet(loadOnStartup=1, urlPattern=”/SomeServlet”)  
XML based  
<load-on-startup>1</load-on-startup>

ServletConfig vs ServletContext





ServletConfig vs ServletContext

ServletConfig: It is the configuration for single servlet  
<init-param> or @WebServlet(initParams = {key : value…. }

ServletConfig cfg = getServletConfig();  
String params = cfg.getInitParameter(“key”);

ServletContext: It is the configuration for all the servlets or entire application

<content-param> is the tag for servlet context  
ServletContext ctx = getServletContext();  
String params = ctx.getInitParameter(“key”);

JSP architecture

a.jsp ---> a\_jsp.java [a servlet] ---> a\_jsp.class ---> HTML

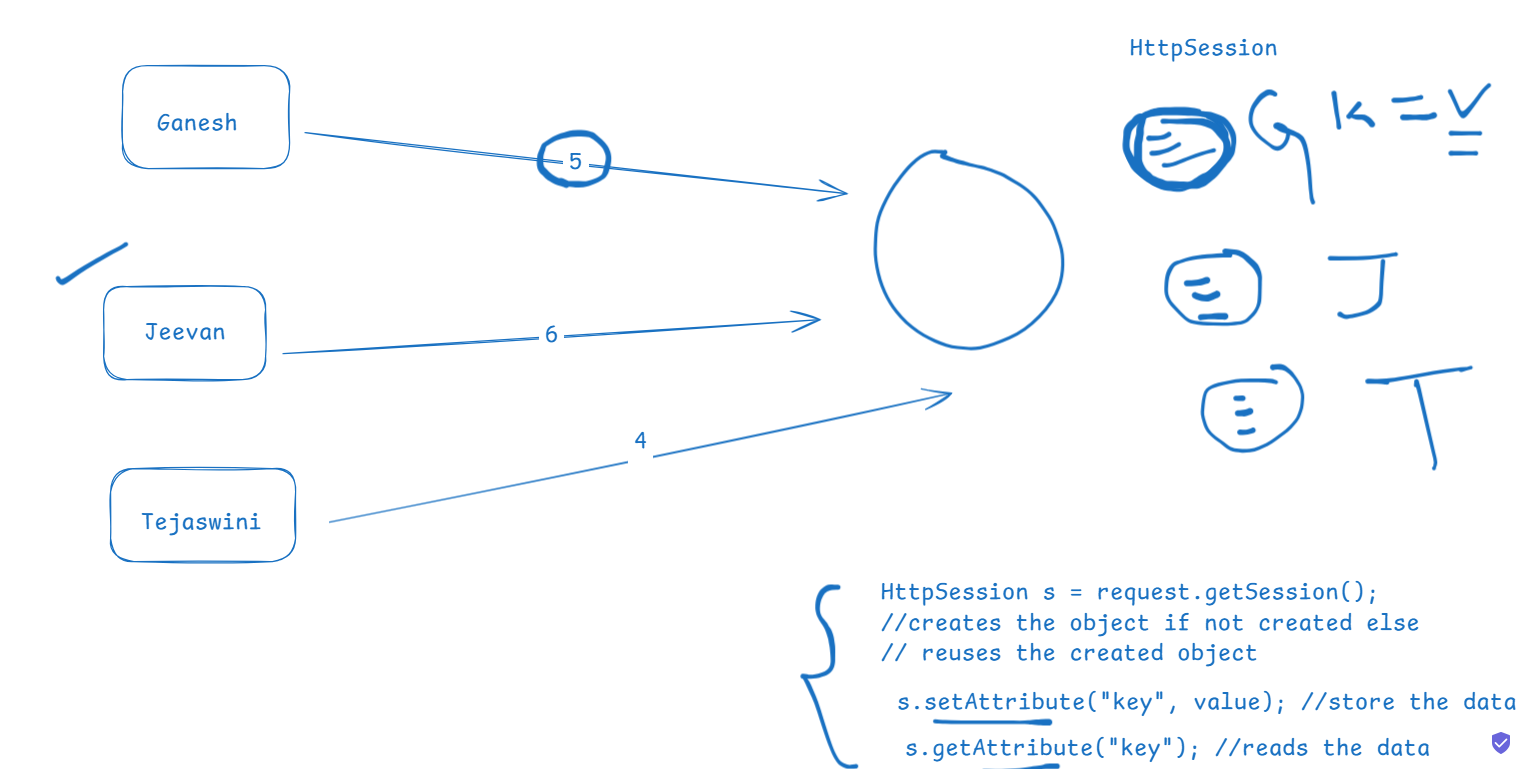
HttpJspBase is the super class of your converted JSP class

Session Management

Http is a stateless protocol, it doesn’t remember the state, every request is treated as the new request.

To manage the session you have 4 mechanism

1. Hidden form fields: This sends previous data in a hidden form so that current request carries the previous data
2. URL-rewriting: This sends the previous data in the URL & embeds in the current request
3. Cookies: This sends the previous data to the client and when client sends the next request the cookies are added and sent so that the next request can read previous request data
4. HttpSession: This creates an object per browser at the server side & stores in the server, each request coming from the same server can identify the previous request data

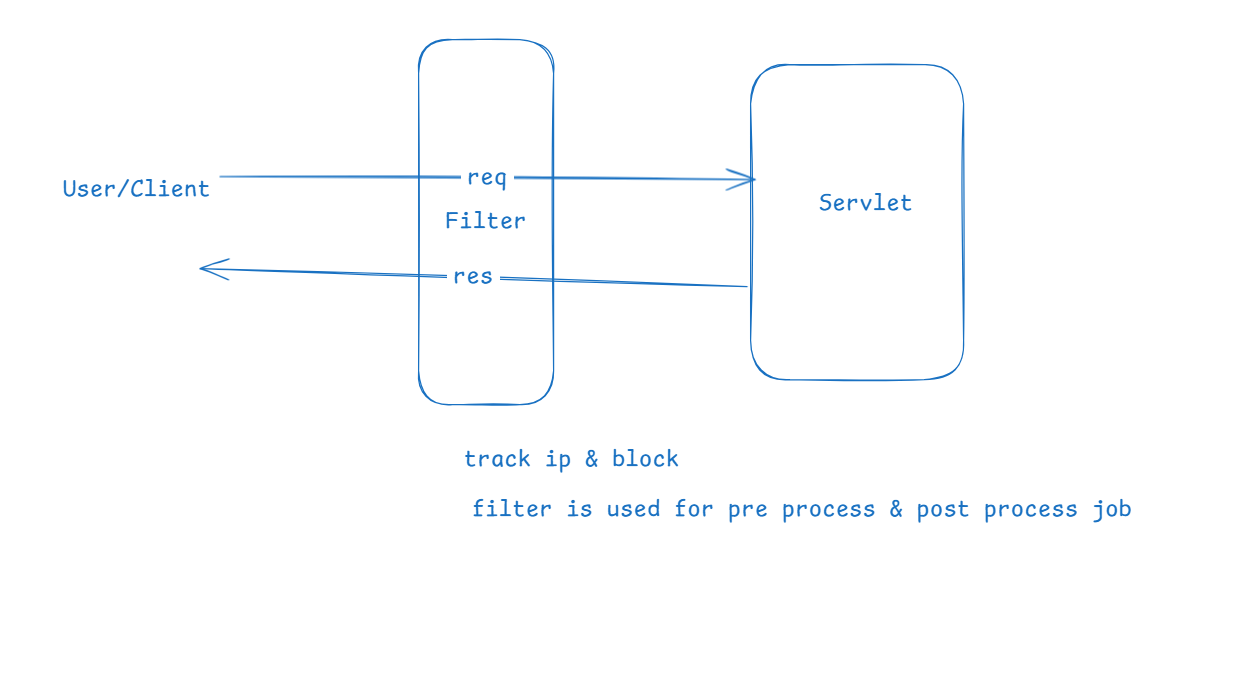


HttpSession important methods

1. boolean isNew(): returns true if session is new else false
2. void setAttribute(key, value):
3. Object getAttribute(key)
4. void removeAttribute(key)
5. invalidate(): to terminate the session

Filters in Servlet

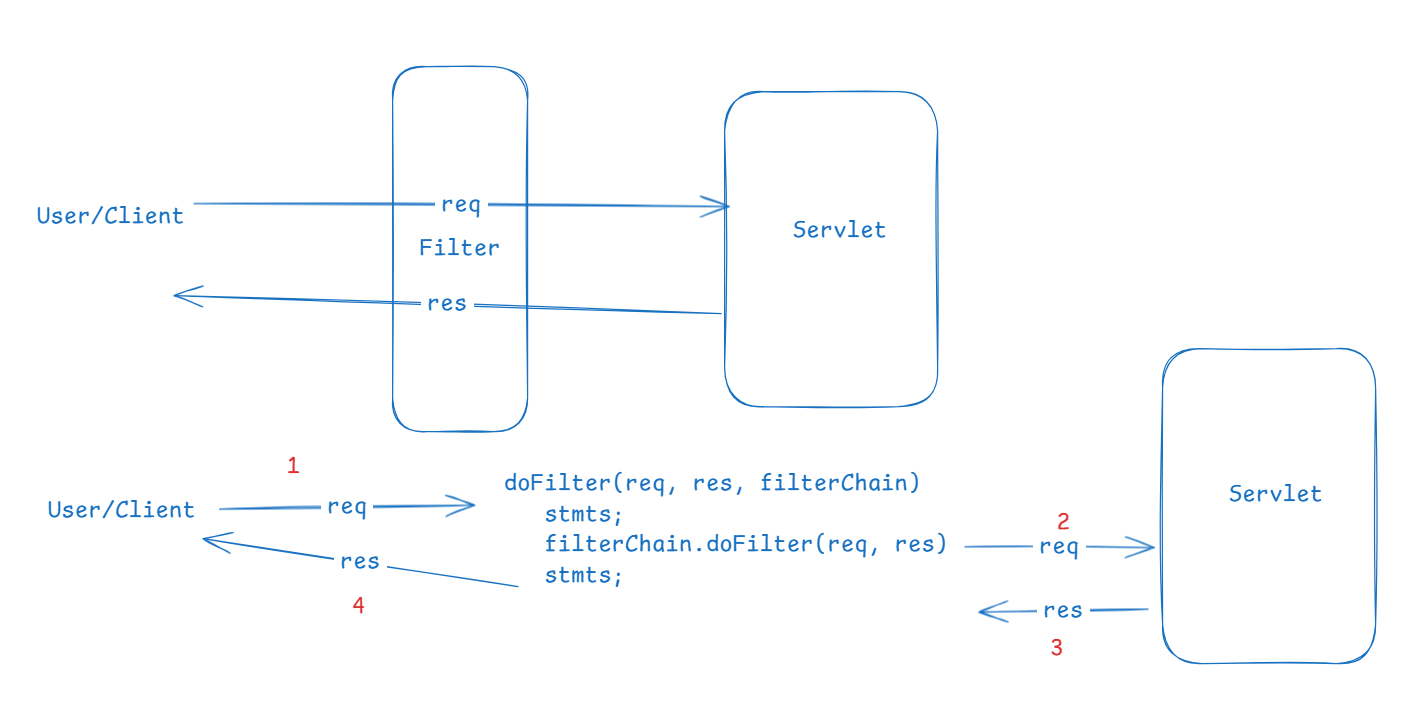
These are intermediate programs which are executed before the request reaches to the servlet & response reaches to the client



How to create Filter

class MyFilter implements Filter {   
 init() { … } //executed when the filter object is created  
 // doFilter is executed when request & response comes  
 doFilter(req, res, filterChain) {

/\* code that executes before request goes to servlet \*/  
 filterChain.doFilter(req, res); // this code sends request to the servlet  
 /\* code that is executed when the response comes from the servlet\*/  
 }  
 destroy() { .. } // when the filter is destroyed  
}



How many methods are there in Filter interface

1. init(FilterConfig)
2. doFilter(ServletRequest, ServletResponse, FilterChain)
3. destroy()

Listeners: These are the programs which are automatically executed when some event happens in the application

1. ServletRequestListener: calls the methods when the request is created / destroyed
2. HttpSessionListener: calls the methods when the session is created / destroyed
3. ServletContextListener: calls the methods when the ServletContext is created / destroyed

Note: These Listeners are interface which you must implement they have methods that executed when certain object is created or destroyed

|  |  |  |
| --- | --- | --- |
| ServletRequestListener | HttpSessionListener | ServletContextListener |
| requestInitialized() | sessionCreated() | contextInitialized() |
| requestDestroyed() | sessionDestroyed() | contextDestroyed() |

Custom tags in JSP

When you want to create your own tags and use in the JSP file, you create custom tags when you want some tags to perform some job then you provide custom tags.

Steps to create custom tags

1. implement Tag interface & override methods like startTag(), endTag() which are executed when the custom tag starts & ends
2. create tld file (tag library descriptor) where you will mention the tag name you want to use in the JSP file & also the implementation of the Tag interface
3. Once you perform above steps server will know what is the tag name and call startTag() and endTag() methods when you start & close the custom tag
4. Use <%@taglib uri = “WEB-INF/abc.tld” prefix=”a” %> to locate the tld file & use the tag with the help of prefix

JSTL

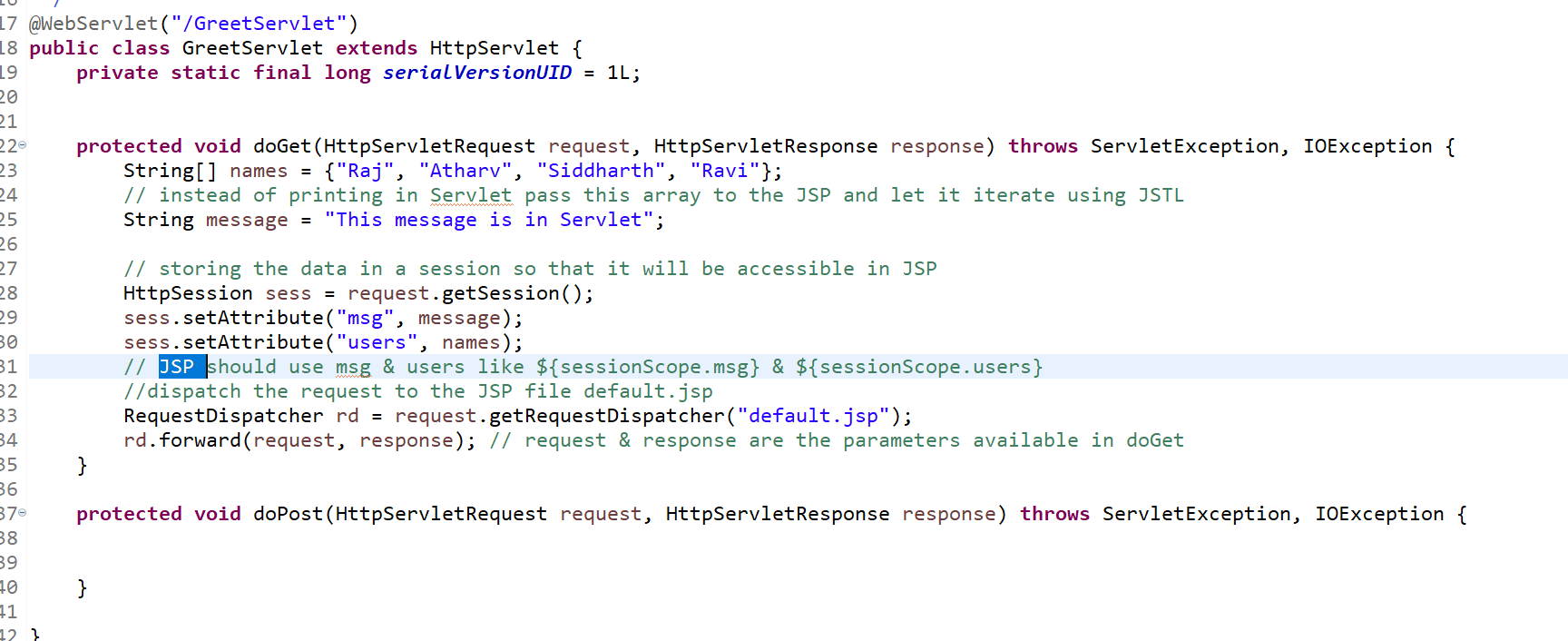
JSTL: Java Standard Tag Library, these are inbuilt tag libraries provided by Java that you can use in JSP files, they perform common operations in the UI like conditions, loops

JSTL Core: It is a tag library that does fundamental operations like variable declarations, conditions & loops

JSTL SQL: It is a tag library that can perform SQL operations using tags

Note: These tag libraries are present in jstl.jar file which you must add in your project and JSP can use <%@taglib > if you want to use the tags provided by JSTL

GreetServlet



Note: Session object is available to Servlet & JSP, in Servlet its HttpSession & in JSP it is ${sessionScope}