Java8 Notes by Vikash

1. **Lambda Expression:**
   Lambda Expression is used to provide the implementation of a Functional Interface. Java Lambda expression is treated as Function.
2. **Functional Interface:**
   A Functional Interface in Java is an Interface that contains only one abstract method but can contains multiple default and static method is called functional interface.
3. **Consumer Functional Interface:**
   Consumer<T> is an in-built Functional Interface introduced in Java 8. Consumer can be used in all contexts where an object needs to be consumed i.e taken as input and some operation is to be performed on the object without returning any result.
   void accept(T t);
   Example:

```
import java.util.function.Consumer;

public class ConsumerExampleUsingOldMethod implements Consumer<Integer> {

    @Override
    public void accept(Integer integer){
        System.out.println("The Number = "+integer);

    }

    public static void main(String[] args) {
        ConsumerExampleUsingOldMethod consumerExampleUsingOldMethod = new
ConsumerExampleUsingOldMethod();
        consumerExampleUsingOldMethod.accept(10);

    }
}
```

```
public class ConsumerExampleUsingLambdaExpression {

    public static void main(String[] args) {
        // So basically "(number) -> System.out.println("The Number =
"+number)" returning Consumer object
        Consumer<Integer> consumer = (number) -> System.out.println("The Number
= "+number);

        // When we are passing this function from any other method like forEach
then automatically this accept method will get called
        consumer.accept(10);
    }
}
```

```
public class UseOfConsumer {

    public static void main(String[] args) {

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

        Consumer<Integer> consumer = (number) -> System.out.println("The Number
= "+number);

        listOfInteger.stream().forEach(consumer);
        // Or - In place of consumer we can direct write whole consumer
function lambda expression in same foreach
```

```
        //listOfInteger.stream().forEach((number) -> System.out.println("The
Number = "+number));
    }
}
```

4. Predicate Function Interface:

This Functional Interface used for conditional check it has only one abstract method

boolean test(T t);

Example:

```
import java.util.function.Predicate;

public class PredicateExampleUsingOldMethod implements Predicate<Integer> {

    @Override
    public boolean test(Integer integer){
        // Checking given number is Odd/Even
        return integer % 2 == 0 ? Boolean.TRUE : Boolean.FALSE;
    }

    public static void main(String[] args) {
        PredicateExampleUsingOldMethod predicateExampleUsingOldMethod = new
PredicateExampleUsingOldMethod();

        System.out.println(predicateExampleUsingOldMethod.test(10));
    }
}
```

```
public class PredicateExampleUsingLambdaExpression {

    public static void main(String[] args) {
        Predicate<Integer> evenOddPredicate = (integer) -> integer % 2 == 0 ?
Boolean.TRUE : Boolean.FALSE;

        System.out.println(evenOddPredicate.test(10));
    }
}
```

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

        Predicate<Integer> evenOddPredicate = (integer) -> integer % 2 == 0 ?
Boolean.TRUE : Boolean.FALSE;

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

        listOfInteger.stream().filter(evenOddPredicate).forEach((t) ->
System.out.println(t));
    }
}
```

5. Supplier Function Interface:

Supplier can be used in all contexts where there is no input but an outputs in expected. It has only one Method

T get();

Example:

```
import java.util.function.Supplier;

public class SupplierExampleUsingOldMethod  implements Supplier<String> {
    @Override
    public String get(){
```

```
        return "This is Vikash";
    }
    public static void main(String[] args) {
        SupplierExampleUsingOldMethod supplierExampleUsingOldMethod = new
SupplierExampleUsingOldMethod();
        System.out.println(supplierExampleUsingOldMethod.get());
    }
}
```

```
public class SupplierExampleUsingLambdaExpression {

    public static void main(String[] args) {
        // Method 1
        Supplier<String> supplier = () -> {
            return "This is Vikash";
        };

        // Method 2 - If we are writing then return key we can not write though
return key word is optional
        Supplier<String> supplier1 = () -> "This is Vikash";

        System.out.println(supplier.get());


    }
}
```

```
public class UseOfSupplier {

    public static void main(String[] args) {

        List<String> list = new ArrayList<>();
        list.add("Vikash");
        list.add("Singh");

        Supplier<String> supplier = () -> "This is first way";

        // If Kumar not found then print suplier msg
        System.out.println(list.stream().filter( string ->
string.equals("Kumar")).findFirst().orElseGet(supplier));

        //If found then pring what ever found
        System.out.println(list.stream().filter( string ->
string.equals("Vikash")).findFirst().orElseGet(supplier));

        list.clear();
        // Since I have clear the list supplier msg will print and purpose of
this code to show we can directly use supplier in here
        System.out.println(list.stream().findAny().orElseGet(() -> "This is
Second way"));
    }
}
```

6. Stream in Java:

- Stream API is use to process collection of Objects.
- A stream is sequence of objects that supports various methods which can be pipelined to produce the desired result.
- A stream is not a data structure instead it takes input from the Collections, Arrays, or I/O channels.
- Stream don't change the original data structure; they only provide the result as per the pipelined methods.

Why we need Stream?

- Functional Programming
- Code Reduce
- Bulk Operations

7. Sorting Using Java Stream:

➢ List Sorting:

```
public class SortingWithPredefinedObjects {

    public static void main(String[] args) {
        List<Integer> list = Arrays.asList(10,40, 20, 30, 50);


        // Ascending order
        System.out.println();
        System.out.println("Ascending order");
        list.stream().sorted().forEach(t -> System.out.print(t + " "));

        // Descending order
        System.out.println();
        System.out.println("Descending order");
        list.stream().sorted(Comparator.reverseOrder()).forEach(t ->
System.out.print(t + " "));

        List<Integer> list2 = new ArrayList<>();
        list2.add(2);
        list2.add(50);
        list2.add(30);
        list2.add(null);

        // Descending order with Null as Last
        System.out.println();
        System.out.println("Descending order with Null as Last");

list2.stream().sorted(Comparator.nullsLast(Comparator.reverseOrder())).fo
rEach(t -> System.out.print(t + " "));

    }
}
```

```
public class SortingWithCustomObjects {

    public static void main(String[] args) {
        List<Employee> employeeList = new ArrayList<>();
        employeeList.add(new Employee(1, "Vikash", 30000.00));
        employeeList.add(new Employee(2, "Sonu", 30000.00));
        employeeList.add(new Employee(3, "Kumar", 10000.00));
        employeeList.add(new Employee(4, "Singh", 50000.00));
        employeeList.add(new Employee(5, "Vikaram", 50000.00));

        // Using Old Method of Java - Ascending
        System.out.println("Using Old Method");
        System.out.println("In Ascending of Java");
        Collections.sort(employeeList, (object1, object2) ->
object1.getSalary().compareTo(object2.getSalary()));
        employeeList.stream().forEach(t -> System.out.println(t));

        // Using Old Method of Java - Descending
        System.out.println();
```

```
        System.out.println("In Descending of Java");
        Collections.sort(employeeList, (object1, object2) -> -
object1.getSalary().compareTo(object2.getSalary()));
        employeeList.stream().forEach(t -> System.out.println(t));

        // By Using Stream API
        System.out.println();
        System.out.println("-----------------------------------------------
-----");
        System.out.println("Using Stream API - Ascending");

employeeList.stream().sorted(Comparator.comparing(Employee::getSalary)).f
orEach(t -> System.out.println(t));

        System.out.println("Using Stream API - Descending");

employeeList.stream().sorted(Comparator.comparing(Employee::getSalary,
Comparator.reverseOrder())).forEach(t -> System.out.println(t));

        System.out.println();
        System.out.println("----------------------Null handle------------
----------------");
        System.out.println("Using Stream API with Null at last -
Descending");
        employeeList.add(new Employee(4, "Test", null));
        // If we will not add
Comparator.nullsLast(Comparator.reverseOrder()) then we will get null
pointer exception

employeeList.stream().sorted(Comparator.comparing(Employee::getSalary,
Comparator.nullsLast(Comparator.reverseOrder()))).forEach(t ->
System.out.println(t));

        System.out.println();
        System.out.println("----------------------Then compare-----------
-----------------");
        System.out.println("Using Stream API with Then compare and null
at last - Descending");
        employeeList.add(new Employee(4, "Test", null));
        // If we will not add
Comparator.nullsLast(Comparator.reverseOrder()) then we will get null
pointer exception

employeeList.stream().sorted(Comparator.comparing(Employee::getSalary,
Comparator.nullsLast(Comparator.reverseOrder())).thenComparing(Employee::
getEmployeeName,
Comparator.nullsLast(Comparator.reverseOrder()))).forEach(t ->
System.out.println(t));
    }
  }
}

public class Employee{
    private Integer employeeId;
    private String employeeName;
    private Double salary;

    public Employee(Integer employeeId, String employeeName, Double
salary) {
        this.employeeId = employeeId;
        this.employeeName = employeeName;
```

```
        this.salary = salary;
    }

    public Integer getEmployeeId() {
        return employeeId;
    }

    public void setEmployeeId(Integer employeeId) {
        this.employeeId = employeeId;
    }

    public String getEmployeeName() {
        return employeeName;
    }

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

    public Double getSalary() {
        return salary;
    }

    public void setSalary(Double salary) {
        this.salary = salary;
    }

    @Override
    public String toString() {
        return "Employee{" +
                "employeeId=" + employeeId +
                ", employeeName='" + employeeName + '\'' +
                ", salary=" + salary +
                '}';
    }
}
```

➢ Map Sorting:

```
public class MapSortingWithPredefinedObjects {

    public static void main(String[] args) {
        Map<String, Integer> map = new HashMap<>();
        map.put("eight", 8);
        map.put("four", 4);
        map.put("ten", 10);
        map.put("two", 2);
        map.put("six", 6);

        // Sort by Key - Sorting Map by Using old approach
        System.out.println("-----------Sort by Key - Sorting Map by Using
old approach-----------");
        List<Map.Entry<String, Integer>> entries = new
ArrayList<>(map.entrySet());
        Collections.sort(entries, new Comparator<Map.Entry<String,
Integer>>() {
            @Override
            public int compare(Map.Entry<String, Integer> o1,
Map.Entry<String, Integer> o2) {
                return o1.getKey().compareTo(o2.getKey());
            }
```

```
        });

        for(Map.Entry<String, Integer> entry : entries){
            System.out.println(entry.getKey()+" : "+entry.getValue());
        }

        System.out.println("-----------Sort by Value - Sorting Map by
Using old approach-----------");
        Collections.sort(entries, new Comparator<Map.Entry<String,
Integer>>() {
            @Override
            public int compare(Map.Entry<String, Integer> o1,
Map.Entry<String, Integer> o2) {
                return o1.getValue().compareTo(o2.getValue());
            }
        });

        for(Map.Entry<String, Integer> entry : entries){
            System.out.println(entry.getKey()+" : "+entry.getValue());
        }

        System.out.println("-----------Sort by Value Ascending- Sorting
Map by Using Lambda Expression-----------");
        Collections.sort(entries, (object1, object2) ->
object1.getValue().compareTo(object2.getValue()));

        for(Map.Entry<String, Integer> entry : entries){
            System.out.println(entry.getKey()+" : "+entry.getValue());
        }
        // ------------------- Lambda Expression ------------------------
-----------------------------------------
        System.out.println("-----------Sort by Value Descending - Sorting
Map by Using Lambda Expression-----------");
        Collections.sort(entries, (object1, object2) -> -
object1.getValue().compareTo(object2.getValue()));

        for(Map.Entry<String, Integer> entry : entries){
            System.out.println(entry.getKey()+" : "+entry.getValue());
        }

        /* ------------------- Using Java8 Stream API -------------------
---------------------------------------*/
        System.out.println("---------------------Using Java8 Stream API -
Ascending By Key---------------------");

map.entrySet().stream().sorted(Map.Entry.comparingByKey()).forEach(t ->
System.out.println(t));

        System.out.println("---------------------Using Java8 Stream API -
Ascending By Value---------------------");

map.entrySet().stream().sorted(Map.Entry.comparingByValue()).forEach(t ->
System.out.println(t));

        System.out.println("---------------------Using Java8 Stream API -
Descending By Value---------------------");
   // VVI
map.entrySet().stream().sorted(Map.Entry.comparingByValue(Comparator.reve
rseOrder())).forEach(t -> System.out.println(t));

        System.out.println("---------------------Using Java8 Stream API -
```

```
Descending By Value null at last----------------------");
        map.put("three", null);
    // VVI
map.entrySet().stream().sorted(Map.Entry.comparingByValue(Comparator.nullsLast(Comparator.reverseOrder()))).forEach(t -> System.out.println(t));
    }
}
```

```
public class MapSortingWithCustomObjects {

    public static void main(String[] args) {
        Map<Employee, Integer> map = new HashMap<>();
        map.put(new Employee(1, "Vikash", 50000.0), 8);
        map.put(new Employee(2, "Singh", 20000.0), 4);
        map.put(new Employee(3, "Kumar", 30000.0), 10);
        map.put(new Employee(4, "Sonu", 60000.0), 2);
        map.put(new Employee(5, "Sachin", 80000.0), 6);

        // Ascending
        System.out.println("------------Ascending by Key Salary----------
--");

map.entrySet().stream().sorted(Map.Entry.comparingByKey(Comparator.compar
ing(Employee::getSalary))).forEach(t -> System.out.println(t));

        // Descending
        System.out.println();
        System.out.println("------------Descending by Key Salary---------
---");

map.entrySet().stream().sorted(Map.Entry.comparingByKey(Comparator.compar
ing(Employee::getSalary, Comparator.reverseOrder()))).forEach(t ->
System.out.println(t));
        // Descending
        System.out.println();
        System.out.println("------------Descending by Key Salary null at
Last------------");
        map.put(new Employee(6, "Test", null), 6);

map.entrySet().stream().sorted(Map.Entry.comparingByKey(Comparator.compar
ing(Employee::getSalary,
Comparator.nullsLast(Comparator.reverseOrder())))).forEach(t ->
System.out.println(t));
    }
}
```

8. Map() vs flatMap():

- Java Stream API provides map() and flatMap() methods. Both these methods are intermediate methods and returns another stream as part of the output.
- map() method used for transformation
- flatMap() used for transformation & flattering
- **flatMap() -> map() + flattering**

map() : (Means Data Transformation)

- map() takes Stream<T> as input and return Stream<R>
- Stream<R> map(Stream<R> input){}
  Syntax: <R> Stream<R> map(Function<? Super T, ? extends R> mapper);

- It's mapper function produces single value for each input value; hence it is also called One-To-One mapping.

flatMap() : (Means Map + Flattering)

- FlatMap() takes Stream<Stream<T>> (also called Stream of Stream) as input and returns Stream<R>
- Stream<R> flatMap(Stream<Stream<T>> input) {}
- Syntax: <R> Stream<R> flatMap(Function<? Super T, ? extends Stream<? extends R>> mapper);
- It's mapper function produces multiple value for each input value hence it is also called One-To-Many mapping

What is Data Transformation & Flattering?

Data Transformation:

Converting Stream.of(a, b, c, d) into A, B, C, D. Here converting lower to upper case called mapping and return it as another stream called data transformation and the entire process is called transforming the data.

Flattering:

Let's assume we have data like [[1, 2], [3, 4], [4, 5], [5, 6], [7, 8]] i.e Once stream contains another Stream now, I want to combine all the sub stream into a single stream this conversion of stream called as Flattering.

```
public class MapVsFlatMap {

    public static void main(String[] args) {

        List<Customer> customers = Stream.of(
                new Customer(101, "john", "john@gmail.com",
Arrays.asList("397937955", "21654725")),
                new Customer(102, "smith", "smith@gmail.com",
Arrays.asList("89563865", "2487238947")),
                new Customer(103, "peter", "peter@gmail.com",
Arrays.asList("38946328654", "3286487236")),
                new Customer(104, "kely", "kely@gmail.com",
Arrays.asList("389246829364", "948609467"))
        ).collect(Collectors.toList());

        //List<Customer>  convert List<String> -> Data Transformation
        //mapping : customer -> customer.getEmail()
        //customer -> customer.getEmail()  one to one mapping because one
customer has only one email in this scenario
        System.out.println("------------Normal map() example------------
");
        List<String> emails = customers.stream().map(customer ->
customer.getEmail()).collect(Collectors.toList());
        System.out.println(emails);

        //customer -> customer.getPhoneNumbers()  ->> one to many mapping
        System.out.println("------------Getting Phone number by using
map() which will return List of List------------");
        List<List<String>> phoneNumbers = customers.stream().map(customer
-> customer.getPhoneNumbers()).collect(Collectors.toList());
        System.out.println(phoneNumbers);

        // So if we want to merge all the list in a single list then we
can use flatMapFunction
        //List<Customer>  convert List<String> -> Data Transformation
        //mapping : customer -> phone Numbers
        //customer -> customer.getPhoneNumbers()  ->> one to many mapping
```

```
        because in this scenario we have multiple phone numbers
                List<String> phones = customers.stream().flatMap(customer ->
        customer.getPhoneNumbers().stream()).collect(Collectors.toList());
                System.out.println(phones);
            }
        }

Customer.class
public class Customer {

    private int id;
    private String name;
    private String email;
    private List<String> phoneNumbers;

    public Customer() {
    }

public Customer(int id, String name, String email, List<String> phoneNumbers)
{
        this.id = id;
        this.name = name;
        this.email = email;
        this.phoneNumbers = phoneNumbers;
    }

    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;
    }

    public String getEmail() {
        return email;
    }

    public void setEmail(String email) {
        this.email = email;
    }

    public List<String> getPhoneNumbers() {
        return phoneNumbers;
    }

    public void setPhoneNumbers(List<String> phoneNumbers) {
        this.phoneNumbers = phoneNumbers;
    }

    @Override
    public String toString() {
        return "Customer{" +
```

```
                "id=" + id +
                ", name='" + name + '\'' +
                ", email='" + email + '\'' +
                ", phoneNumbers=" + phoneNumbers +
                '}';
    }
}
```

Differences between Java 8 Map() Vs flatMap() :

map()	flatMap()
It processes stream of values.	It processes stream of stream of values.
It does only mapping.	It performs mapping as well as flattening.
It's mapper function produces single value for each input value.	It's mapper function produces multiple values for each input value.
It is a One-To-One mapping.	It is a One-To-Many mapping.
Data Transformation : From Stream to Stream	Data Transformation : From Stream<Stream to Stream
Use this method when the mapper function is producing a single value for each input value.	Use this method when the mapper function is producing multiple values for each input value.

9. Optional:

Optional is final class which having lot of methods to deal with normal Java object. It is a container object may or may not contains non-null value.

Java provides 3 methods to create Optional object.

1. empty() – It will create empty optional object
2. of() – It create option object of type give but if passing object is null then it will throw null pointer exception, So it is not recommended to use this method util we are sure that there will be no null value for that object.
3. ofNullable() – **It is recommended to use this method to get Optional object in place to of() method because first it checking if object is null then it will return empty optional object and if not null then it will return option object of passed type**.

   Note: .orElse(String) this method takes string and orElseGet(Suplier) and orElseThorw() – this method takes supplier so make sure you are passing or proper lambda from these methods like () -> new Exception("Object not found"), since supplier have only one abstract method "T get()" i.e its takes no argument but returning one value.

```
public class OptionDemo {

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

        Employee employee = new Employee(1, null, 4000.0);
        Employee employeeVikash = new Employee(2, "Vikash", 4000.0);

        // This method will return null since name is null
        /*Optional<String> employeeOptional =
Optional.of(employee.getEmployeeName());
        System.out.println(employeeOptional);*/

        // If null then print Optional.empty
        Optional<String> employeeOptional1 =
Optional.ofNullable(employee.getEmployeeName());
        System.out.println(employeeOptional1);

        // In this if null then returning some msg
        Optional<String> employeeOptional2 =
```

```
Optional.ofNullable(employee.getEmployeeName());
        System.out.println(employeeOptional2.orElse("No name present"));

        // We can use other stream api method optional provide us liberty
that if we want we
        // can perform some operation or else return some default value
        Optional<String> employeeOptional3 =
Optional.ofNullable(employee.getEmployeeName());

System.out.println(employeeOptional3.map(String::toUpperCase).orElse("No
name present"));

        // If some present then changing to Upper case and no value then
returning default value
        Optional<String> employeeOptional4 =
Optional.ofNullable(employeeVikash.getEmployeeName());

System.out.println(employeeOptional4.map(String::toUpperCase).orElse("No
name present"));
    }
}
```

10. Map() and reduce():

- Map and reduce is a functional programming model it serves our two purpose
  Map – Transforming Data
  Reduce – Aggerating Data (Combining elements of stream and produces a single value)
- Ex: Stream: [2, 4, 6, 9, 1, 3, 7] Sum of numbers present in stream.
- Reduce() – Combine stream of int and produce the sum result.

Reduce:

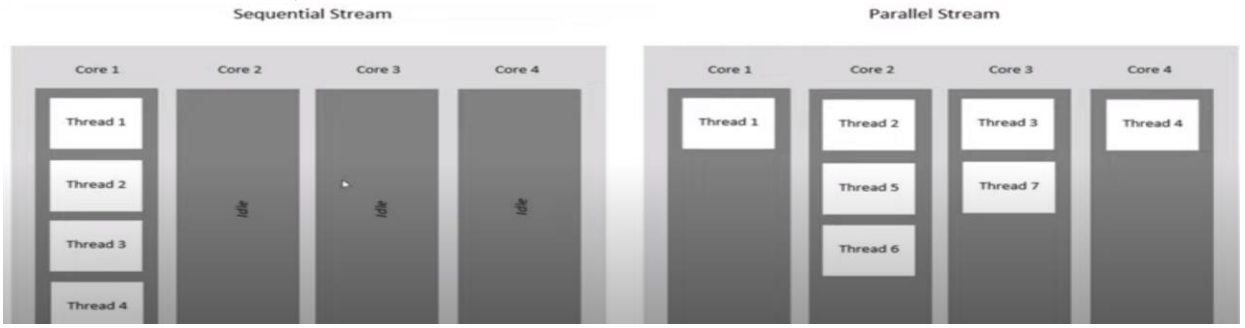
- T reduce (T identity, BinaryOperator<T> accumulator);
- Identity is initial value for type T
- Accumulator is function for combining two values
- Integer sumResult = Stream.of(2, 4, 6, 9, 1, 3, 7).**reduce(0, (a, b) -> a+b)**;
  In the above example Identity 0 which is nothing but initial value and Accumulator: (a,b) -> a+b is function.

```
public class MapReduceDemo {

    public static void main(String[] args) {

        List<Integer> numbers = Arrays.asList(3, 7, 8, 1, 5, 9);

        List<String> words = Arrays.asList("corejava", "spring",
"hibernate");

        int sum1 = numbers.stream().mapToInt(i -> i).sum();
        System.out.println(sum1);

        Integer reduceSum = numbers.stream().reduce(0, (a, b) -> a + b);
        System.out.println(reduceSum);

        Optional<Integer> reduceSumWithMethodReference =
numbers.stream().reduce(Integer::sum);
        System.out.println(reduceSumWithMethodReference.get());

        Integer mulResult = numbers.stream().reduce(1, (a, b) -> a * b);
        System.out.println(mulResult);
```

```
        Integer maxvalue = numbers.stream().reduce(0, (a, b) -> a > b ? a
: b);
        System.out.println(maxvalue);

        Integer maxvalueWithMethodReference =
numbers.stream().reduce(Integer::max).get();
        System.out.println(maxvalueWithMethodReference);


        String longestString = words.stream()
                .reduce((word1, word2) -> word1.length() > word2.length()
? word1 : word2)
                .get();
        System.out.println(longestString);

        List<Employee> employeeList = Stream.of(new
Employee(101,"john","A",60000),
                        new Employee(109,"peter","B",30000),
                        new Employee(102,"mak","A",80000),
                        new Employee(103,"kim","A",90000),
                        new Employee(104,"json","C",15000))
                .collect(Collectors.toList());

        //get employee whose grade A
        //get salary
        double avgSalary = employeeList.stream()
                .filter(employee ->
employee.getGrade().equalsIgnoreCase("A"))
                .map(employee -> employee.getSalary())
                .mapToDouble(i -> i)
                .average().getAsDouble();

        System.out.println(avgSalary);

        double sumSalary = employeeList.stream()
                .filter(employee ->
employee.getGrade().equalsIgnoreCase("A"))
                .map(employee -> employee.getSalary())
                .mapToDouble(i -> i)
                .sum();
        System.out.println(sumSalary);
    }
}
```

11. Parallel Streams:

- Java Parallel Streams is a feature of Java 8, It meant for utilizing multiple cores of the processor
- Normally any Java code has one stream of processing, where it is executed sequentially. Where by using parallel streams, we can divide the code into multiple streams that are executed in parallel on separate cores and the final result is the combination of the individual outcomes
- Then Order of execution, however is not under control.



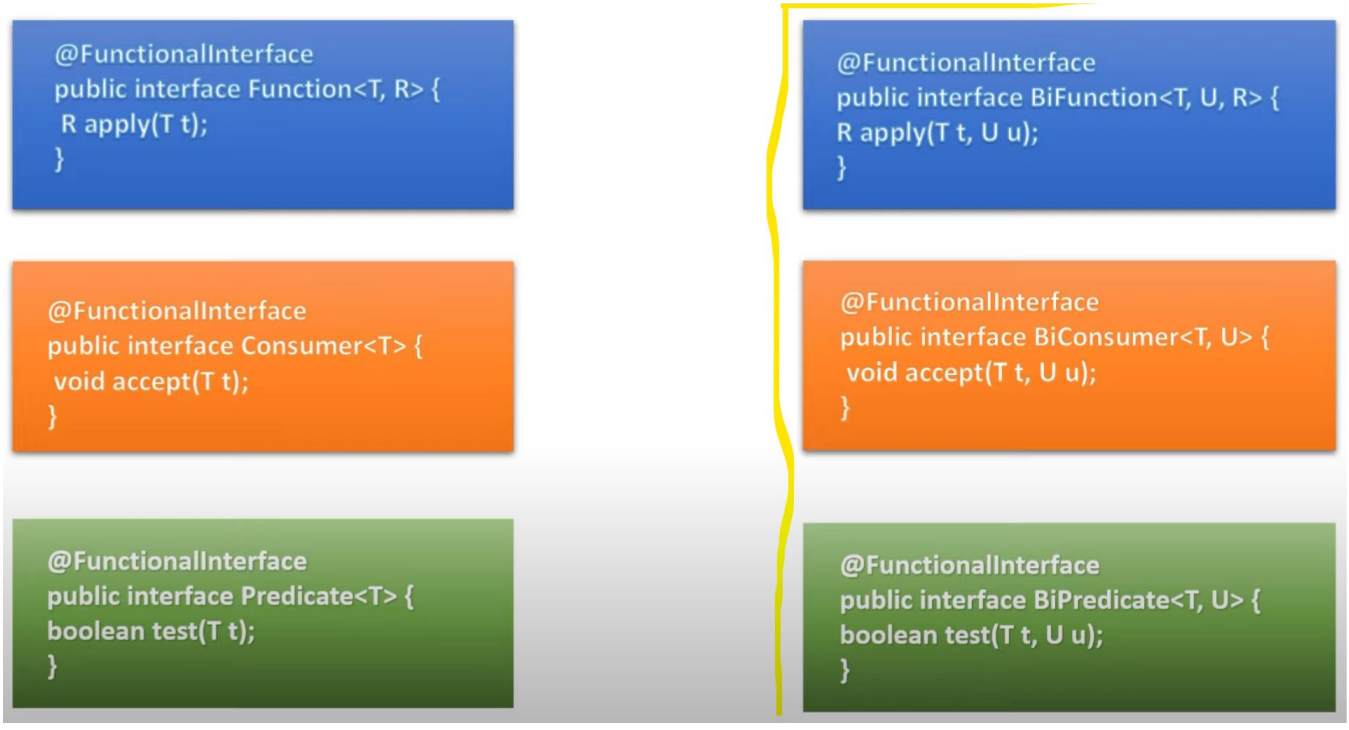
Note: Parallel Stream uses ForkJoinPool for multithreading.

```
public class ParallelStreamDemo {
    public static void main(String[] args) {
        long start = 0;
        long end = 0;

        // Printing 1 to 100 using sequential stream
        start = System.currentTimeMillis();
        IntStream.range(1, 100).forEach(x -> {
            System.out.print(x + " ");
        });
        end = System.currentTimeMillis();

        System.out.println();
        System.out.println("Total time taken to print 1 to 100 by sequential
stream = "+(end - start));

        // Printing 1 to 100 using parallel stream
        start = System.currentTimeMillis();
        System.out.println();
        IntStream.range(1, 100).parallel().forEach(x -> {
            System.out.print(x + " ");
        });
        end = System.currentTimeMillis();
        System.out.println();
        System.out.println("Total time taken to print 1 to 100 by parallel
stream = "+(end - start));

        // ======================== Thread name and printing values
=======================
        // Printing 1 to 100 using sequential stream with Thread Name
        start = System.currentTimeMillis();
        System.out.println("======================== Thread name and printing
values ========================");
        System.out.println();
        IntStream.range(1, 100).forEach(x -> {
            System.out.println("Thread "+Thread.currentThread().getName()+" :
"+x);
        });
        end = System.currentTimeMillis();
        System.out.println("Total time taken to print 1 to 100 by sequential
stream with thread= "+(end - start));

        // Printing 1 to 100 using Parallel stream with Thread Name
        start = System.currentTimeMillis();
        System.out.println();
        IntStream.range(1, 100).parallel().forEach(x -> {
            System.out.println("Thread "+Thread.currentThread().getName()+" :
"+x);
        });
        end = System.currentTimeMillis();
        System.out.println("Total time taken to print 1 to 100 by parallel
stream with thread = "+(end - start));

        // ======================== Working with Employee Objects
=======================

        System.out.println("Working with Employee Objects");
```

```
        // Creating 1000 objects of Employee and finding average salary
        start = System.currentTimeMillis();
        List<Employee> employeeList = getEmployeeList();
        employeeList.stream().map(employee ->
employee.getSalary()).mapToDouble(i -> i).average();
        end = System.currentTimeMillis();
        System.out.println("Finding average salary of employee by using
sequential stream "+(end - start));

        start = System.currentTimeMillis();
        List<Employee> employeeList2 = getEmployeeList();
        employeeList2.parallelStream().map(employee ->
employee.getSalary()).mapToDouble(i -> i).average();
        end = System.currentTimeMillis();
        System.out.println("Finding average salary of employee by using
parallel stream "+(end - start));



    }

    public static List<Employee> getEmployeeList(){
        List<Employee> employeeList = new ArrayList<>();
        for(int i = 0; i<= 1000; i++){
            employeeList.add(new Employee(i, "Employee_name"+i, new
Random().nextDouble()));
        }
        return employeeList;
    }
}
```

12. BiFunctional Interface/ BiConsumer/ BiPredicate:

It is same as Function the only difference is that it takes 2 inputs:



BiFunction Program:

```
public class BiFunctionDemoByOldApproach implements BiFunction<List<Integer>,
List<Integer>, List<Integer>> {

    @Override
    public List<Integer> apply(List<Integer> list1, List<Integer> list2){
        return Stream.of(list1,
list2).flatMap(List::stream).distinct().collect(Collectors.toList());
    }

    public static void main(String[] args) {
        List<Integer> list1 = Stream.of(1, 3, 4, 6, 7, 9,
19).collect(Collectors.toList());
        List<Integer> list2 = Stream.of(11, 3, 43, 6, 7,
19).collect(Collectors.toList());

        BiFunctionDemoByOldApproach biFunctionDemoByOldApproach = new
BiFunctionDemoByOldApproach();
        List<Integer> list3 = biFunctionDemoByOldApproach.apply(list1, list2);
        System.out.println(list3);
    }
}
```

```
public class BiFunctionDemoByLambdaExpression {

    public static void main(String[] args) {

        // Output - [1, 3, 4, 6, 7, 9, 19, 11, 43]
        List<Integer> listWithData1 = Stream.of(1, 3, 4, 6, 7, 9,
19).collect(Collectors.toList());
        List<Integer> listWithData2 = Stream.of(11, 3, 43, 6, 7,
19).collect(Collectors.toList());

        BiFunction<List<Integer>, List<Integer>, List<Integer>> biFunction = (list1,
list2) -> Stream.of(list1,
list2).flatMap(List::stream).distinct().collect(Collectors.toList());

        List<Integer> listAfterMerge = biFunction.apply(listWithData1,
listWithData2);
        System.out.println(listAfterMerge);

    }
}
```

```
public class ApplicationOfBiFunction {

    public static void main(String[] args) {

        Map<String, Integer> map=new HashMap<>();
        map.put("basant",5000);
        map.put("santosh",15000);
        map.put("javed",12000);

        System.out.println("Before: "+map);
        BiFunction<String, Integer, Integer> salaryIncremental = (key, value) ->
value + 500;
        map.replaceAll(salaryIncremental);

        System.out.println("After: "+map);

        // We can directly use lambda expression inside replaceAll method
```

```
        System.out.println("Before adding 1000: "+map);
        map.replaceAll((key, value) -> value + 1000);
        System.out.println("After adding 1000: "+map);
    }
}
```

```
public class ApplicationOfBiFunction2 {

    public static void main(String[] args) {

        List<Integer> listWithData1 = Stream.of(1, 3, 4, 6, 7, 9,
19).collect(Collectors.toList());
        List<Integer> listWithData2 = Stream.of(11, 3, 43, 6, 7,
19).collect(Collectors.toList());

        BiFunction<List<Integer>, List<Integer>, List<Integer>> biFunction = (list1,
list2) -> Stream.of(list1,
list2).flatMap(List::stream).distinct().collect(Collectors.toList());

        // This is function to use andThen method of BiFunction
        Function<List<Integer>, List<Integer>> sortFunction = (rowList) ->
rowList.stream().sorted().collect(Collectors.toList());

        List<Integer> listAfterMergeUnsorted = biFunction.apply(listWithData1,
listWithData2);
        System.out.println("Un-Sorted = "+ listAfterMergeUnsorted);

        List<Integer> listAfterMergeSorted =
biFunction.andThen(sortFunction).apply(listWithData1, listWithData2);
        System.out.println("Sorted = "+ listAfterMergeSorted);

    }
}
```

BiCosumer:

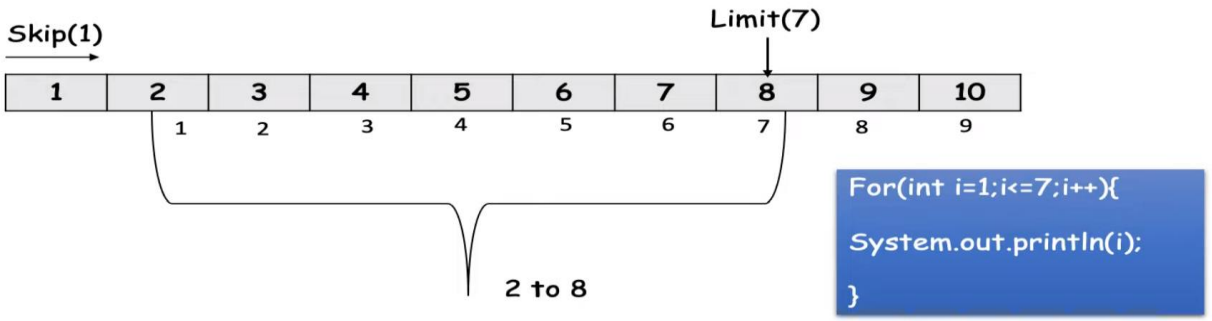
```
public class BiConsumerDemoByOldApproach implements BiConsumer<String,Integer> {

    @Override
    public void accept(String i1, Integer i2) {
        System.out.println("input 1 "+i1 +": input 2 "+i2);
    }

    public static void main(String[] args) {
        BiConsumer<String,Integer> biConsumer=new BiConsumerDemoByOldApproach();
        biConsumer.accept("javatechie",53000);
    }
}
```

```
public class BiConsumerDemoByLambdaExpression {

    public static void main(String[] args) {
        BiConsumer<String,Integer> biConsumer = (firstValue, secondValue) -> {
            System.out.println("input 1 "+ firstValue +": input 2 "+ secondValue);
        };

        biConsumer.accept("test", 10);
    }
}
```

```
public class BiConsumerApplication {

    public static void main(String[] args) {
        Map<String, Integer> map=new HashMap<>();
```

```
        map.put("basant",5000);
        map.put("santosh",15000);
        map.put("javed",12000);

        map.forEach((k,v)-> System.out.println(k+","+v));
    }
}
```

13. Skip() & limit(): (VVI asked in interview)



Skip operation is useful when we want to discard some number elements from actual collection.

```
public class SkipAndLimitDemo {

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

        // Print 2 to 8
        list.stream().skip(1).limit(7).forEach(t -> System.out.print(t+" "));

        // Print 3 to 9
        System.out.println();
        list.stream().skip(2).limit(7).forEach(t -> System.out.print(t+" "));
    }
}
```

```
public class SkipAndLimitApplication {

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

        List<String> fileData = Files.readAllLines(Paths.get("data.txt"));

        // Read and print all the data of file
        fileData.forEach(System.out::println);

        // Now Remove the header of the file
        System.out.println("\n=============After Removing of header of the
File=============");
        fileData.stream().skip(1).forEach(System.out::println);

        // Now Remove the header of the file
        System.out.println("\n=============After Removing of header and footer
of the File=============");
        fileData.stream().skip(1).limit(fileData.size()-
2).forEach(System.out::println);
    }
}
```

File data: (Add this data.txt in direct project folder)

```
id    name       qty     price
101   Mobile     1       50000
102   watch      2       4000
103   TV         1       75000
104   HeadSet    3       15000
105   Books      1       1
                 8       100000
```

CompletableFuture

1. What is CompletableFuture?

CompletableFuture: A new era of asynchronous programming

- Using Asynchronous programming you can write non-blocking code where concurrently you can run N no of task in separate thread without blocking main thread.
- When the task is complete it notifies to the main thread (whether the task was complete or failed)

2. What is CompletableFuture?

There are different ways to implements asynchronous programming in Java, like **Futures**, **ExecutorService**, CallBack interfaces, Thread Pools etc.

Disadvantage of Future:

1. It can not manually completed
2. Multiple Futures cannot be chained together
3. We can not combine multiple Futures together
4. No Proper Exception Handling Mechanism

3. Executor vs ExecutorService:

Sr. No.	Key	Executor	ExecutorServices
1	Basic	It is a parent interface	It extends Executor Interface
2	Method	It has execute() method	It has submit() method
3	Return Type	It does not return anything .	It return future object.
4.	Runnable /Callable	It accept runnable object.	It accept both runnable and callable

4. Executor framework built in thread pools:

- Fixed Thread Pool
- Cached Thread Pool
- Scheduled Thread Pool
- Single Thread Executor

5. Difference between the submit() and execute() method in Java Concurrency?

1) The submit() can accept both Runnable and Callable tasks but execute() can only accept the Runnable task.

2) The submit() method is declared in the ExecutorService interface while the execute() method is declared in the Executor interface.

3) The return type of submit() method is a Future object but the return type of execute() method is void.

```
import java.util.Arrays;
import java.util.List;
import java.util.concurrent.*;

public class WhyNotFuture {
    public static void main(String[] args) throws ExecutionException,
InterruptedException {
```

```
        ExecutorService executorService = Executors.newFixedThreadPool(10);
        Future<List<Integer>> submit = executorService.submit(() -> {
            return Arrays.asList(1, 2, 3, 4);
        });

        List<Integer> list = submit.get();

        list.stream().forEach(System.out::println);

        // We do not have any feature to combine, manually/forcefully complete
the task we cannot chain multiple futures and no exception handling
    }
    public static void delay(int min){
        try{
            TimeUnit.MINUTES.sleep(min);
        }catch (InterruptedException e){
            e.printStackTrace();
        }
    }
}
```

```
public class CompletableFutureDemo1 {

    public static void main(String[] args) throws ExecutionException,
InterruptedException {
        // How to create object and get and manually complete the execution
        CompletableFuture<String> completableFuture = new
CompletableFuture<>();
        // Here we are blocking the thread to get the result
        completableFuture.get();
        // if get is taking more time than we can complete the thread by
        // using compete() method as below
        completableFuture.complete("Return some dummy data...");
    }
}
```

6. What is runAsync() and supplyAsync():

If we want to run some background task asynchronous and **do not want to return** anything from that task then use CompletableFuture.runAsync() method. It takes a Runnable object and returns CompletableFuture<Void>.

1. CompletableFuture.runAsync(Runnable) – (In case of Runnable this method get the thread from ForkJoinPool)
2. CompletableFuture.runAsync(Runnable, Executor) – (In that case thread will be taken from executor)

If we want to run some background task asynchronously and want to return anything from that task, we should use CompletableFuture.supplyAsync(). It takes a Supplier<T> and returns CompletableFuture<T> where T is the type of the value obtained by calling the given supplier

1. CompletableFuture.supplyAsync(Supllier<T>)
2. CompletableFuture.supplyAsync(Supllier<T>, Executor)

```
public class RunAsyncDemo {

    public Void saveEmployees(File jsonFile) throws ExecutionException,
InterruptedException {
        ObjectMapper mapper = new ObjectMapper();
        CompletableFuture<Void> runAsyncFuture = CompletableFuture.runAsync(new
Runnable() {

            @Override
            public void run() {
                try {
                    List<Employee> employees = mapper.readValue(jsonFile, new
TypeReference<Object>() {
                            });
                    //write logic t save list of employee to database
                    //repository.saveAll(employees);
                    System.out.println("Thread : " +
Thread.currentThread().getName());
                    System.out.println(employees);
                    System.out.println(employees.size());
                } catch (IOException e) {
                    e.printStackTrace();
                }
            }
        });

        return runAsyncFuture.get();
    }

    public Void saveEmployeesByLambda(File jsonFile) throws ExecutionException,
InterruptedException {
        ObjectMapper mapper = new ObjectMapper();
        CompletableFuture<Void> runAsyncFuture = CompletableFuture.runAsync(() -> {

                try {
                    List<Employee> employees = mapper.readValue(jsonFile, new
TypeReference<Object>() {
                    });
                    //write logic t save list of employee to database
                    //repository.saveAll(employees);
                    System.out.println("Thread : " +
Thread.currentThread().getName());
                    System.out.println(employees);
                    System.out.println(employees.size());
                } catch (IOException e) {
                    e.printStackTrace();
                }
        });

        return runAsyncFuture.get();
    }

    public Void saveEmployeesWithCustomExecutor(File jsonFile) throws
ExecutionException, InterruptedException {
        ObjectMapper mapper = new ObjectMapper();
        Executor executor = Executors.newFixedThreadPool(5);
        CompletableFuture<Void> runAsyncFuture = CompletableFuture.runAsync(
                () -> {
                    try {
                        List<Employee> employees = mapper
                                .readValue(jsonFile, new
```

```
TypeReference<List<Employee>>() {
                                    });
                            //write logic t save list of employee to database
                            //repository.saveAll(employees);
                            System.out.println("Thread : " +
Thread.currentThread().getName());
                            System.out.println(employees.size());
                        } catch (IOException e) {
                            e.printStackTrace();
                        }
                    },executor);

        return runAsyncFuture.get();
    }

    public static void main(String[] args) throws ExecutionException,
InterruptedException {
        RunAsyncDemo runAsyncDemo = new RunAsyncDemo();
        // runAsyncDemo.saveEmployees(new File("employees.json"));
        // runAsyncDemo.saveEmployeesByLambda(new File("employees.json"));
        runAsyncDemo.saveEmployeesWithCustomExecutor(new File("employees.json"));
    }
}
```

```
public class SupplyAsyncDemo {

    public List<Employee> getEmployees() throws ExecutionException,
InterruptedException {
        CompletableFuture<List<Employee>> listCompletableFuture = CompletableFuture
                .supplyAsync(() -> {
                    System.out.println("Executed by : " +
Thread.currentThread().getName());
                    return fetchEmployees();
                });
        return listCompletableFuture.get();
    }

    public List<Employee> getEmployeesWithExecutor() throws ExecutionException,
InterruptedException {
        Executor executor = Executors.newCachedThreadPool();
        CompletableFuture<List<Employee>> listCompletableFuture = CompletableFuture
                .supplyAsync(() -> {
                    System.out.println("Executed by : " +
Thread.currentThread().getName());
                    return fetchEmployees();
                },executor);
        return listCompletableFuture.get();
    }

    public static List<Employee> fetchEmployees() {
        ObjectMapper mapper = new ObjectMapper();
        try {
            return mapper.readValue(new File("employees.json"), new
TypeReference<List<Employee>>() {
                    });
        } catch (IOException e) {
            e.printStackTrace();
        }
        return null;
    }
```

```
    public static void main(String[] args) throws ExecutionException,
InterruptedException {
        SupplyAsyncDemo supplyAsyncDemo = new SupplyAsyncDemo();
        List<Employee> employees = supplyAsyncDemo.getEmployees();
        employees.stream().forEach(System.out::println);
    }
}
```

```
public class Employee {
    private String employeeId;
    private String firstName;
    private String lastName;
    private String email;
    private String gender;
    private String newJoiner;
    private String learningPending;
    private int salary;
    private int rating;

    public String getEmployeeId() {
        return employeeId;
    }

    public void setEmployeeId(String employeeId) {
        this.employeeId = employeeId;
    }

    public String getFirstName() {
        return firstName;
    }

    public void setFirstName(String firstName) {
        this.firstName = firstName;
    }

    public String getLastName() {
        return lastName;
    }

    public void setLastName(String lastName) {
        this.lastName = lastName;
    }

    public String getEmail() {
        return email;
    }

    public void setEmail(String email) {
        this.email = email;
    }

    public String getGender() {
        return gender;
    }

    public void setGender(String gender) {
        this.gender = gender;
    }

    public String getNewJoiner() {
        return newJoiner;
```

```
    }

    public void setNewJoiner(String newJoiner) {
        this.newJoiner = newJoiner;
    }

    public String getLearningPending() {
        return learningPending;
    }

    public void setLearningPending(String learningPending) {
        this.learningPending = learningPending;
    }

    public int getSalary() {
        return salary;
    }

    public void setSalary(int salary) {
        this.salary = salary;
    }

    public int getRating() {
        return rating;
    }

    public void setRating(int rating) {
        this.rating = rating;
    }
}
```

---

7. thenApply(Function)/thenApplyAsync(Function), thenAccept(Consumer)/ thenAcceptAsync(Consumer), thenRun(Runnable)/thenRunAsync(Runnable)

```
public class EmployeeReminderService {

    public CompletableFuture<Void> sendNewJoinerNotCompletedReminder(){

        CompletableFuture<Void> voidCompletableFuture =
CompletableFuture.supplyAsync(() -> {
            System.out.println("fetchEmployee : " +
Thread.currentThread().getName());
            return fetchEmployees();
        }).thenApplyAsync((employees) -> {
            System.out.println("filter new joiner employee  : " +
Thread.currentThread().getName());
            return employees.stream()
                    .filter(employee -> "TRUE".equals(employee.getNewJoiner()))
                    .collect(Collectors.toList());
        }).thenApplyAsync((employees) -> {
            System.out.println("filter training not complete employee  : " +
Thread.currentThread().getName());
            return employees.stream()
                    .filter(employee -> "TRUE".equals(employee.getLearningPending()))
                    .collect(Collectors.toList());
        }).thenApplyAsync((employees) -> {
            System.out.println("get emails  : " + Thread.currentThread().getName());
            return
employees.stream().map(Employee::getEmail).collect(Collectors.toList());
```

```
        }).thenAcceptAsync((emails) -> {
            System.out.println("send email  : " + Thread.currentThread().getName());
            emails.forEach(email -> sendEmail(email));
        });
        return voidCompletableFuture;
    }

    public CompletableFuture<Void> sendNewJoinerNotCompletedReminderWithoutAsync(){

        CompletableFuture<Void> voidCompletableFuture =
CompletableFuture.supplyAsync(() -> {
            System.out.println("fetchEmployee : " +
Thread.currentThread().getName());
            return fetchEmployees();
        }).thenApply((employees) -> {
            System.out.println("filter new joiner employee  : " +
Thread.currentThread().getName());
            return employees.stream()
                    .filter(employee -> "TRUE".equals(employee.getNewJoiner()))
                    .collect(Collectors.toList());
        }).thenApply((employees) -> {
            System.out.println("filter training not complete employee  : " +
Thread.currentThread().getName());
            return employees.stream()
                    .filter(employee -> "TRUE".equals(employee.getLearningPending()))
                    .collect(Collectors.toList());
        }).thenApply((employees) -> {
            System.out.println("get emails  : " + Thread.currentThread().getName());
            return
employees.stream().map(Employee::getEmail).collect(Collectors.toList());
        }).thenAccept((emails) -> {
            System.out.println("send email  : " + Thread.currentThread().getName());
            emails.forEach(email -> sendEmail(email));
        });
        return voidCompletableFuture;
    }

    public void sendEmail(String email){
        System.out.println("Email sending to email + "+email);
    }


    public static List<Employee> fetchEmployees() {
        ObjectMapper mapper = new ObjectMapper();
        try {
            List<Employee> employees = mapper.readValue(new File("employees.json"),
new TypeReference<List<Employee>>() {});
            System.out.println(employees);
            return mapper.readValue(new File("employees.json"), new
TypeReference<List<Employee>>() {});
        } catch (IOException e) {
            e.printStackTrace();
        }
        return null;
    }

    public static void main(String[] args) {
        EmployeeReminderService employeeReminderService = new
EmployeeReminderService();
        employeeReminderService.sendNewJoinerNotCompletedReminder();
        employeeReminderService.sendNewJoinerNotCompletedReminderWithoutAsync();
```

```
    }
}
```

Java8 Interview Questions:

1. What are all features of Java 8 you have used?
   - Functional Interface (Include default and static methods)
   - Lambda Expression
   - Stream
   - CompaletableFuture
   - Java Date Time API
2. What is Functional Interface?
3. Can you tell few Functional Interface which is already there before Java 8?
4. Can your write one Functional Interface?
5. Can we extends Function Interface from another interface? (Yes, but that will no more FI)
6. What are all Functional Interface Introduced in Java 8?
   - Function
   - Predicate
   - Consumer
   - Supplier
   - BiFunction
   - BiConsumer
   - BiPredicate
7. What is Lambda Expression?
8. What are Advantage and Disadvantage of using Lambda Expression?
   Advantage:
   - Avoid writing anonymous impl
   - It saves Lot of code writing burden
   - The code is directly readable without interpretation

   Disadvantage:
   - Hard to use without an IDE
   - Complex to debug
9. What is Stream API?
   Stream API introduce in Java 8 and it is used to process collections of Objects with functional style of coding using lambda expression.
10. What is Stream in Java 8?
    A Stream is sequence of Object that supports various methods which can be pipelined to produce the desired result.
    The Feature of Java Stream are:
    - A Stream is not a data structure instead its take input from the Collection, Array or I/O channel.
    - Stream do not change the original data structure they only provide the result as per the pipelined method.
11. What is method reference in Java 8?
    Method reference is short hand Notation of a Lambda expression to call a method.
12. Spell few stream methods you used in your project?
    - Filter
    - Foreach
    - Sorted
    - Map
    - flatMap
    - reduce
    - groupingBy(VVI)

- Count
- Collects

13. When to use map and flatMat?
14. WAP using stream to find frequency of each character in given string? - VVI

```
public class FrequencyOfEachChar {
    public static void main(String[] args) {
        String str = "Vikashh";
        Map<String, Long> countOfEachCharacter =
Arrays.stream(str.split("")).collect(Collectors.groupingBy(Function.identity(),
Collectors.counting()));
        System.out.println(countOfEachCharacter);
    }
}
```

15. Assume you have list of employees in various department write a program to highest paid employee from each department?

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

        List<EmployeeInterviewProgramTest> employeeList =
                Arrays.asList(
                        new EmployeeInterviewProgramTest(1, "Vikash", "IT",
40000.0),
                        new EmployeeInterviewProgramTest(2, "Singh", "SOFT",
80000.0),
                        new EmployeeInterviewProgramTest(3, "Kumar",
"BUSINESS", 20000.0),
                        new EmployeeInterviewProgramTest(4, "Sonu", "SECURITY",
90000.0),
                        new EmployeeInterviewProgramTest(5, "Sachin", "IT",
70000.0),
                        new EmployeeInterviewProgramTest(6, "Akash",
"SECURITY", 10000.0),
                        new EmployeeInterviewProgramTest(7, "Soumya", "SOFT",
45000.0),
                        new EmployeeInterviewProgramTest(8, "Nikhil",
"BUSINESS", 85000.0));

        Map<String, List<EmployeeInterviewProgramTest>> employeeFormEachDepart
=
employeeList.stream().collect(Collectors.groupingBy(EmployeeInterviewProgramTes
t::getDepartment));
        System.out.println(employeeFormEachDepart);

        // Finding Highest Salary from each department
        Comparator<EmployeeInterviewProgramTest> comparingHighestPaidSalary =
Comparator.comparing(EmployeeInterviewProgramTest::getSalary);
        Map<String, Optional<EmployeeInterviewProgramTest>>
employeeFormEachDepartWithHighestPaidSalary = employeeList.stream()

.collect(Collectors.groupingBy(EmployeeInterviewProgramTest::getDepartment,
Collectors.reducing(BinaryOperator.maxBy(comparingHighestPaidSalary))));
        System.out.println(employeeFormEachDepartWithHighestPaidSalary);
    }
}
```

16. Stream vs Parallel Stream in Java 8?
    Both are used to process group of object however Stream execute in a single core of machine with sequential flow whereas parallel Stream uses multiple core of machine with parallel flow.
17. What is CompatableFuture?

18. How to Decide ThreadPool Size?
    CPU Intensive task
    IO intensive task
19. Write a program to print Odd and Even number 2 thread.

```
20.  public class OddEvenBy2Thread {

        private static Object object = new Object();

        private static IntPredicate evenCondition = e -> e%2 == 0;
        private static IntPredicate oddCondition = e -> e%2 != 0;

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

            // Odd number printer
            CompletableFuture.runAsync(() ->
   OddEvenBy2Thread.printNumber(oddCondition));

            // Even number printer
            CompletableFuture.runAsync(() ->
   OddEvenBy2Thread.printNumber(evenCondition));

            Thread.sleep(1000);
        }

        public static void printNumber(IntPredicate condition){
            IntStream.rangeClosed(1,
   10).filter(condition).forEach(OddEvenBy2Thread::execute);
        }

        public static void execute(int num){
            synchronized (object){
                try{
                    System.out.println(Thread.currentThread().getName()+" : "+num);
                    object.notify();
                    object.wait();
                }catch (InterruptedException e){
                    e.printStackTrace();
                }
            }

        }
   }
```