Java-8 & it's Features

Trainer Name

Shreyansh Kumar

What is Java 8?

Java 8 is a major release of the Java programming language, officially launched by Oracle on March 18, 2014. It introduced several new features to improve productivity, enhance performance, and provide better support for functional programming. Java 8 brought significant changes to the way developers write Java code by introducing lambda expressions, functional interfaces, the Stream API, and the new Date-Time API.

This version is widely adopted because it enhances readability, reduces boilerplate code, and improves overall efficiency in Java development.

Why is Java 8 Needed?

Before Java 8, developers faced several challenges with Java programming, such as:

1. **Verbose Code** – Java required writing a lot of boilerplate code for simple operations, making programs lengthy and harder to maintain.

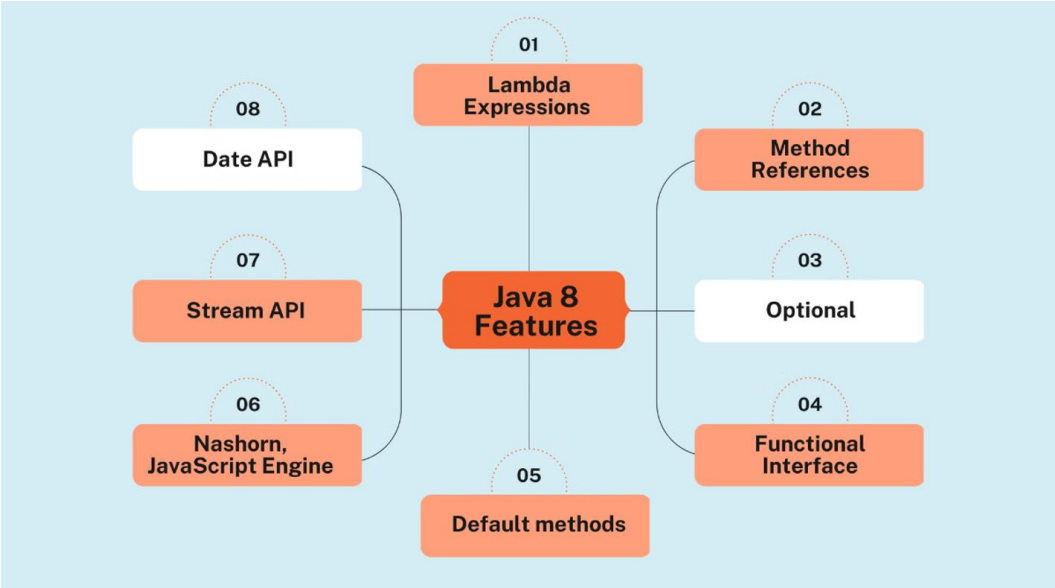
2. **Poor Functional Programming Support** – Java was primarily object-oriented and lacked built-in support for functional programming paradigms.

3. **Inefficient Collection Processing** – Iterating over collections involved external iteration (using loops), which was not optimized for multi-core processors.

4. **Mutable and Error-Prone Date API** – The existing java.util.Date and java.util.Calendar classes had design flaws and thread-safety issues.

5. **Inefficient Handling of Null Values** – NullPointerExceptions (NPEs) were common, leading to unexpected crashes and debugging difficulties.

Java 8 features



Java 8 is a landmark release of the Java programming language that introduced several significant enhancements to improve developer productivity, code readability, and application performance. It marked the arrival of functional programming in Java through lambda expressions and method references, making it easier to write concise, maintainable, and parallel-friendly code. The Stream API revolutionized the way collections are processed by enabling internal iteration and parallel operations, while the Optional class provided a safer alternative to dealing with null values. Java 8 also delivered a more robust Date-Time API to replace the outdated java.util.Date and Calendar classes, along with default methods that allowed interface evolution without breaking existing implementations. Finally, the inclusion of the Nashorn JavaScript engine further expanded Java's versatility by facilitating seamless integration with JavaScript. Together, these features modernized the language and laid the groundwork for future Java releases. Let's discuss all the feature one by one

1. Lambda Expressions

Lambda expressions provide a way to represent anonymous functions (functions without a name) and are primarily used to implement functional interfaces concisely.

Need of Lambda function

- Reduces **boilerplate code** in Java
- Makes **functional programming** possible
- Simplifies the use of **anonymous classes**

Example:

Before Java 8 (Using Anonymous Class)

```
// Implementing Runnable using an anonymous class
Runnable r = new Runnable() {
    @Override
    public void run() {
        System.out.println("Running thread...");
    }
};
new Thread(r).start();
```

With Java 8 (Using Lambda Expression)

```
// Implementing Runnable using Lambda Expression
Runnable r = () -> System.out.println("Running thread...");
new Thread(r).start();
```

Benefits:

- No need to declare a class
- Code is shorter and more readable

2. Method References

Method references provide a shorthand syntax for invoking methods in Java 8, simplifying lambda expressions that merely call an existing method. They allow you to refer to a method without executing it immediately, making your code more concise and readable.

Types of Method References

1. Static Method Reference
    - Syntax: ClassName::staticMethodName
    - Example:
    - Instead of writing:

```
Function<String, Integer> parse = s -> Integer.parseInt(s);
```

We can use this with lambda expression-

```
Function<String, Integer> parse = Integer::parseInt;
```

2. Instance Method Reference of a Particular Object

- **Syntax:** `instance::instanceMethodName`
- **Example:**
  Given an object `printer` of type `PrintStream`, we can replace:
-

```
Consumer<String> printerLambda = s -> System.out.println(s);
```

Benefits of Using Method References

- Conciseness: Reduces boilerplate code by replacing simple lambda expressions.
- Readability: Makes it immediately clear which method is being called.
- Maintainability: Changes in method signatures are easier to manage since the method reference directly ties to an existing method.

3. Default Method

Default methods were introduced in Java 8 to allow developers to add new functionality to interfaces without breaking existing implementations. Prior to Java 8, interfaces could only contain abstract methods, which meant that any change to an interface would require all implementing classes to provide an implementation for the new method. Default methods solve this problem by providing a **default implementation** that the implementing classes can inherit, ensuring backward compatibility.

Key Points

- **Backward Compatibility:**
  Interfaces can evolve over time. New methods can be added without forcing all existing classes to implement them.
- **Method Implementation in Interfaces:**
  Default methods include a method body, unlike traditional abstract methods in interfaces.
- **Multiple Inheritance of Behavior:**
  They allow a form of multiple inheritance, where classes can inherit behavior from multiple interfaces.

Syntax and Example

```java
public interface Greeting {
    // Abstract method
    void sayHello(String name);

    // Default method
    default void greet(String name) {
        System.out.println("Hello, " + name + "! Welcome to Java 8.");
    }
}

public class Greeter implements Greeting {
    // Implementing the abstract method
    @Override
    public void sayHello(String name) {
        System.out.println("Hi, " + name + "!");
    }

    // No need to override greet() if default behavior is acceptable
}

public class Main {
    public static void main(String[] args) {
        Greeter greeter = new Greeter();
        greeter.sayHello("Alice");  // Output: Hi, Alice!
        greeter.greet("Alice");     // Output: Hello, Alice! Welcome to Java 8.
    }
}
```

In this example:

- The Greeting interface defines an abstract method sayHello and a default method greet.
- The Greeter class implements the abstract method sayHello but inherits the default implementation of greet from the interface.
- When greet is called on an instance of Greeter, it executes the default method defined in the interface.

Benefits

- **Interface Evolution:**
  Easily add new functionality to interfaces without forcing every implementing class to update.
- **Code Reusability:**
  Provide common behavior that can be shared among multiple classes, reducing duplicate code.
- **Simplified API Design:**
  Enable richer APIs in interfaces, allowing them to act as mixins that offer concrete behavior alongside abstract definitions.

4. Functional Interface

A functional interface in Java is an interface that contains *exactly one* abstract method. It can have any number of default or static methods, but the presence of only one abstract method is what makes it functional. These interfaces are crucial for using lambda expressions and method references, which are concise ways to represent anonymous functions.
Why are Functional Interfaces Important?

- Lambda Expressions: Lambda expressions provide a way to define anonymous functions (functions without a name) inline. They are often used to implement functional interfaces. The lambda expression's signature must match the abstract method's signature in the functional interface.
- Method References: Method references are a shorthand for lambda expressions when the lambda expression simply calls an existing method. They also work with functional interfaces.
- Functional Programming: Functional interfaces are a core concept in functional programming, enabling you to treat functions as first-class citizens (i.e., pass them as arguments to other functions, return them from functions, and assign them to variables).

Types of Functional Interfaces (Commonly Used Examples)

While you can create your own functional interfaces, Java provides several built-in functional interfaces in the java.util.function package that cover many common use cases. These pre-defined interfaces reduce the need to write your own for typical scenarios. Here are some key categories and examples:

1. **Function<T, R>:** Represents a function that accepts one argument of type T and produces a result of type R.

```
Function<String, Integer> stringLength = str -> str.length(); // Lambda expres
int length = stringLength.apply("Hello"); // length will be 5
```

2. **Consumer<T>:** Represents an operation that accepts a single input argument of type T and returns no result (void). Used for side effects.

```
Consumer<String> printMessage = str -> System.out.println(str);
printMessage.accept("Hello, World!");
```

3. **Predicate<T>:** Represents a predicate (boolean-valued function) of one argument of type T.

```
Predicate<Integer> isEven = num -> num % 2 == 0;
boolean result = isEven.test(10); // result will be true
```

4. **Supplier<T>:** Represents a supplier of results of type T. It takes no arguments.

```
Supplier<Double> randomValue = () -> Math.random();
double value = randomValue.get();
```

5. **UnaryOperator<T>:** Represents an operation on a single operand of type T that produces a result of the same type T. A special case of Function<T, T>.

```
UnaryOperator<Integer> square = num -> num * num;
int squared = square.apply(5); // squared will be 25
```

6. **BinaryOperator<T>:** Represents an operation upon two operands of the same type T that produces a result of the same type T. A special case of BiFunction<T, T, T>.

```
BinaryOperator<Integer> sum = (a, b) -> a + b;
int total = sum.apply(10, 20); // total will be 30
```

7. **BiFunction<T, U, R>:** Represents a function that accepts two arguments of types T and U and produces a result of type R.

```
BiFunction<String, String, Integer> stringLengthSum = ( String s1,  String s2) -> s1.length() + s2.length();
int totalLength = stringLengthSum.apply( t: "Hello",  u: "World"); // totalLength will be 10
```

8. **BiConsumer<T, U>:** Represents an operation that accepts two input arguments of types T and U and returns no result.

```
BiConsumer<String, Integer> printNameAndAge = ( String name,  Integer age) -> System.out.println(name + " is " + age + " years old.");
printNameAndAge.accept( t: "Alice",  u: 30);
```

Key points to remember:

- The @FunctionalInterface annotation is optional but recommended. It helps the compiler enforce that your interface has only one abstract method.
- Functional interfaces are essential for using lambda expressions and method references, which make your code more concise and readable.
- The java.util.function package provides a wide range of pre-defined functional interfaces for common use cases. Use these whenever possible to avoid reinventing the wheel.

5. Optional

java.util.Optional is a container object that may or may not contain a non-null value. It's designed to address the problem of NullPointerExceptions by explicitly representing the presence or absence of a value. Think of it as a wrapper around a value that might be there, or might not.

Why Use Optional?

- Explicitly Handle Absence of a Value: Optional forces you to consider the case where a value might be absent, making your code more robust and less prone to NullPointerExceptions. It shifts the responsibility of null checks from the caller to the callee.
- Improved Code Readability: Using Optional makes your code more expressive. It clearly communicates that a value is optional, improving readability and maintainability.
- Functional Style: Optional provides methods that support a functional style of programming, such as map, flatMap, and filter.

How to Create Optional Objects:

- Optional.of(value): Creates an Optional with the specified non-null value. If you pass null to this method, it will throw a NullPointerException. Use this only when you are *absolutely certain* the value is not null.

```
Optional<String> name = Optional.of("Alice");
```

- Optional.ofNullable(value): Creates an Optional with the specified value, or an empty Optional if the value is null. This is the most common way to create Optional objects, especially when dealing with values that might be null.

```
String potentiallyNullValue = null; // Or "Bob"
Optional<String> name = Optional.ofNullable(potentiallyNullValue);
```

- **Optional.empty():** Creates an empty Optional.

```
Optional<String> empty = Optional.empty();
```

Key Optional Methods:

- **isPresent():** Returns true if a value is present, otherwise false.

```
if (name.isPresent()) {
    System.out.println("Name is present: " + name.get());
}
```

- • **`get()`:** Returns the value if present. Throws a `NoSuchElementException` if the `Optional` is empty. **Avoid using `get()` directly unless you've already checked with `isPresent()` or are absolutely sure a value is present.**
- • **`orElse(other)`:** Returns the value if present, otherwise returns `other`. A convenient way to provide a default value.

```
String nameValue = name.orElse("Unknown");
```

- **`orElseGet(supplier)`:** Returns the value if present, otherwise returns the result of the `supplier`. Useful when the default value is expensive to compute.

```
String nameValue = name.orElseGet(() -> {
    // Expensive operation to compute default value
    return "Default Name";
});
```

Important Considerations:

- **Avoid Optional as a Field:** Generally, avoid using Optional as a field in your classes. It adds complexity and is usually not necessary. Use it as a return type or for local variables.
- **Don't Overuse:** Optional is not a replacement for all null checks. Use it judiciously where it adds clarity and helps prevent NullPointerExceptions. Overusing it can make your code more complex.

6. Stream API

The Java Stream API, introduced in Java 8, is a powerful way to process collections of objects in a declarative and functional style. It allows you to perform operations like filtering, mapping, sorting, and reducing data in a concise and efficient manner. Streams are not data structures themselves; they are a sequence of elements that are processed through a pipeline of operations.

Key Concepts:

- Stream: A sequence of elements supporting sequential and parallel aggregate operations.
- Pipeline: A sequence of stream operations. A stream pipeline consists of a source, zero or more intermediate operations, and a terminal operation.
- Source: Where the stream originates from (e.g., a collection, an array, I/O channel, or a generator function).
- Intermediate Operations: Transform a stream into another stream. Examples include filter, map, sorted, distinct, peek, limit, skip. Intermediate operations are *lazy*; they are not executed until a terminal operation is encountered.
- Terminal Operations: Produce a result or perform a side effect. Examples include forEach, collect, reduce, count, min, max, anyMatch, allMatch, noneMatch, findFirst, findAny, toArray. Terminal operations are *eager*; they trigger the execution of the pipeline.

Example:

```java
List<Integer> numbers = Arrays.asList(1, 2, 3, 4, 5, 6, 7, 8, 9, 10);

// Calculate the sum of even numbers greater than 3
int sum = numbers.stream()
        .filter( Integer n -> n > 3 && n % 2 == 0) // Intermediate operation: Filter even numbers > 3
        .map( Integer n -> n * 2) // Intermediate operation: Double the numbers
        .reduce( identity: 0, Integer::sum); // Terminal operation: Sum the results

System.out.println("Sum of even numbers greater than 3 doubled: " + sum); // Output: 30

// Another example: Get a list of squares of odd numbers
List<Integer> squaresOfOdd = numbers.stream()
        .filter( Integer n -> n % 2 != 0) // Intermediate operation: Filter odd numbers
        .map( Integer n -> n * n) // Intermediate operation: Square the numbers
        .collect(Collectors.toList()); // Terminal operation: Collect into a list

System.out.println("Squares of odd numbers: " + squaresOfOdd); // Output: [1, 9, 25, 49, 81]


// Example using strings
List<String> names = Arrays.asList("Alice", "Bob", "Charlie", "David", "Eve");
List<String> longNames = names.stream()
        .filter( String name -> name.length() > 3) // Filter names longer than 3 characters
        .map(String::toUpperCase) // Convert to uppercase
        .sorted() // Sort alphabetically
        .collect(Collectors.toList()); // Collect results into a List
System.out.println(longNames); // Output: [ALICE, BOB, CHARLIE, DAVID]
```

Java stream API Methods

1. Creation Method

Method	Description	Example
Stream.of(T... values)	Creates a stream from values.	Stream<Integer> stream = Stream.of(1, 2, 3, 4, 5);
Arrays.stream(T[] array)	Converts an array into a stream.	int[] arr = {1, 2, 3}; Stream<int[]> stream = Arrays.stream(arr);
Collection.stream()	Converts a collection into a stream.	List<String> list = Arrays.asList("A", "B"); Stream<String> stream = list.stream();
Stream.iterate(T seed, UnaryOperator<T> f)	Generates an infinite stream using an iterative function.	Stream.iterate(0, n -> n + 2).limit(5).forEach(System.out::println);
Stream.generate(Supplier<T> s)	Generates an infinite stream using a supplier function.	Stream.generate(Math::random).limit(5).forEach(System.out::println);
IntStream.range(int start, int end)	Creates an IntStream with a range of numbers (excluding end).	IntStream.range(1, 5).forEach(System.out::println);
IntStream.rangeClosed(int start, int end)	Creates an IntStream with a range of numbers (including end).	IntStream.rangeClosed(1, 5).forEach(System.out::println);

2. Intermediate Operations (Transformations)

Method	Description	Example

filter(Predicate<T> predicate)	Filters elements based on a condition.	list.stream().filter(x -> x > 10).forEach(System.out::println);
map(Function<T, R> mapper)	Transforms each element using a function.	list.stream().map(String::toUpperCase).forEach(System.out::println);
flatMap(Function<T, Stream<R>> mapper)	Flattens a stream of streams into a single stream.	listOfLists.stream().flatMap(Collection::stream).forEach(System.out::println);
distinct()	Removes duplicate elements.	list.stream().distinct().forEach(System.out::println);
sorted()	Sorts elements in natural order.	list.stream().sorted().forEach(System.out::println);
sorted(Comparator<T> comparator)	Sorts elements using a custom comparator.	list.stream().sorted(Comparator.reverseOrder()).forEach(System.out::println);
peek(Consumer<T> action)	Performs an action on each element without modifying the stream.	list.stream().peek(System.out::println).count();
limit(long maxSize)	Limits the number of elements in the stream.	list.stream().limit(3).forEach(System.out::println);
skip(long n)	Skips the first `n` elements of the stream.	list.stream().skip(2).forEach(System.out::println);

3. Terminal Operations (Producing Results)

Method	Description	Example
collect(Collector<T, A, R> collector)	Collects elements into a collection.	List<String> result = list.stream().collect(Collectors.toList());
forEach(Consumer<T> action)	Performs an action on each element.	list.stream().forEach(System.out::println);
toArray()	Converts a stream into an array.	String[] array = list.stream().toArray(String[]::new);
reduce(BinaryOperator<T> accumulator)	Reduces elements into a single value.	int sum = list.stream().reduce(0, Integer::sum);
count()	Returns the count of elements in the stream.	long count = list.stream().count();
min(Comparator<T> comparator)	Finds the minimum element.	Optional<Integer> min = list.stream().min(Integer::compare);
max(Comparator<T> comparator)	Finds the maximum element.	Optional<Integer> max = list.stream().max(Integer::compare);
findFirst()	Returns the first element.	Optional<String> first = list.stream().findFirst();
findAny()	Returns any element.	Optional<String> any = list.stream().findAny();
anyMatch(Predicate<T> predicate)	Returns `true` if any element matches the condition.	boolean match = list.stream().anyMatch(x -> x.contains("A"));
allMatch(Predicate<T> predicate)	Returns `true` if all elements match the condition.	boolean match = list.stream().allMatch(x -> x.length() > 2);
noneMatch(Predicate<T> predicate)	Returns `true` if no element matches the condition.	boolean match = list.stream().noneMatch(x -> x.startsWith("Z"));

4. Collectors (For `collect()` method)

Method	Description	Example
Collectors.toList()	Collects elements into a	List<String> list =

	`List`.	stream.collect(Collectors.toList());
Collectors.toSet()	Collects elements into a `Set`.	Set<String> set = stream.collect(Collectors.toSet());
Collectors.toMap(Function<T, K> keyMapper, Function<T, V> valueMapper)	Collects elements into a `Map`.	Map<Integer, String> map = list.stream().collect(Collectors.toMap(String::length, Function.identity()));
Collectors.groupingBy(Function<T, K> classifier)	Groups elements by a key.	Map<Integer, List<String>> grouped = list.stream().collect(Collectors.groupingBy(String::length));
Collectors.partitioningBy(Predicate<T> predicate)	Partitions elements into two groups (true/false).	Map<Boolean, List<String>> partitioned = list.stream().collect(Collectors.partitioningBy(x -> x.length() > 3));
Collectors.counting()	Counts the number of elements.	long count = list.stream().collect(Collectors.counting());
Collectors.summingInt(ToIntFunction<T> mapper)	Sums integer values.	int sum = list.stream().collect(Collectors.summingInt(String::length));
Collectors.averagingInt(ToIntFunction<T> mapper)	Computes the average of integer values.	double avg = list.stream().collect(Collectors.averagingInt(String::length));
Collectors.joining(CharSequence delimiter)	Joins elements into a string.	String joined = list.stream().collect(Collectors.joining(", "));

7. DateTime API

Why a New API?

The old Date and Calendar APIs had several issues:

- Mutability: Date objects are mutable, leading to potential bugs when they are unintentionally modified.
- Complex API: The API was often confusing and inconsistent.
- Lack of Clarity: It wasn't always clear what a Date object represented (a point in time, a date, or a date and time).
- Time Zone Handling: Time zone handling was cumbersome and error-prone.

The Java DateTime API addresses these problems with a well-designed, immutable, and comprehensive set of classes.

Key Classes and Concepts:

- LocalDate: Represents a date (year, month, day) without a time or time zone.

```
LocalDate today = LocalDate.now(); // Current date
LocalDate specificDate = LocalDate.of(2024, 10, 26); // October 26, 2024
```

- **LocalTime:** Represents a time (hour, minute, second, nanosecond) without a date or time zone.

```
LocalTime currentTime = LocalTime.now(); // Current time
LocalTime specificTime = LocalTime.of(10, 30, 0); // 10:30 AM
```

- **LocalDateTime:** Represents a date and time without a time zone.

```
LocalDateTime now = LocalDateTime.now(); // Current date and time
LocalDateTime specificDateTime = LocalDateTime.of(2024, 10, 26, 10, 30);
```

- **ZonedDateTime:** Represents a date and time with a time zone. Use this when you need to handle time zones explicitly.

```
ZoneId zone = ZoneId.of("America/New_York");
ZonedDateTime zonedDateTime = ZonedDateTime.now(zone);
```

- **OffsetDateTime:** Represents a date and time with an offset from UTC. Similar to ZonedDateTime, but uses an offset instead of a time zone.
- **Instant:** Represents a point in time on the UTC timeline. Useful for timestamps and machine time.

```
Instant nowInstant = Instant.now();
```

- **Duration**: Represents a time duration (e.g., 2 hours, 30 minutes).

```
Duration duration = Duration.ofHours(2).plusMinutes(30);
```

- **Period:** Represents a period of time in terms of years, months, and days.

```
Period period = Period.ofYears(1).ofMonths(2).ofDays(10);
```

- **DateTimeFormatter:** Used for formatting and parsing dates and times.

```
LocalDateTime now = LocalDateTime.now(); // Current date and time
DateTimeFormatter formatter = DateTimeFormatter.ofPattern("yyyy-MM-dd HH:mm:ss");
String formattedDateTime = now.format(formatter); // Format LocalDateTime
LocalDateTime parsedDateTime = LocalDateTime.parse( text: "2024-10-26 10:30:00", formatter); // Parse LocalDateTime
```

JAVA 8 Interview theory Questions

1. What is a functional interface and why is it important in Java 8?
Answer: A functional interface is an interface that declares exactly one abstract method. It's the foundation for lambda expressions and method references, enabling functional programming patterns in Java. The @FunctionalInterface annotation enforces this contract at compile time.

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2. How do lambda expressions simplify code compared to anonymous inner classes?
Answer: Lambda expressions offer a more concise syntax by eliminating the boilerplate code associated with anonymous inner classes. They allow you to define behavior inline, improving readability and maintainability.

---

3. Explain method references and provide an example of their usage.
Answer: Method references are a shorthand notation for calling a method via a lambda expression. They come in four forms (static, instance, constructor, and arbitrary object instance). For example, instead of writing (s) -> s.toLowerCase(), you can write String::toLowerCase.

---

4. What is a Stream in Java 8 and how does it differ from a Collection?
Answer: A Stream represents a sequence of elements supporting aggregate operations (such as filter, map, and reduce) without storing data. Unlike collections, streams are designed for functional-style processing and support lazy evaluation and parallel execution.

---

5. What are the key differences between sequential and parallel streams?
Answer: Sequential streams process elements one after the other, while parallel streams divide the workload across multiple threads using the Fork/Join framework. Parallel streams can offer performance gains on multi-core systems but require caution regarding thread safety and order.

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6. Describe the concept of lazy evaluation in streams.
Answer: Lazy evaluation means that intermediate operations (like filter or map) are not executed until a terminal operation (such as collect or reduce) is invoked. This approach can optimize performance by avoiding unnecessary computations.

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7. What is Optional in Java 8 and how does it improve null handling?
Answer: Optional is a container that may or may not contain a non-null value. It reduces the risk of NullPointerException by providing methods like isPresent(), ifPresent(), and orElse(), thus encouraging explicit handling of absent values.

8. Explain the new Date-Time API introduced in Java 8.
Answer: The new Date-Time API (in the java.time package) offers immutable and thread-safe classes such as LocalDate, LocalTime, and LocalDateTime. It addresses many shortcomings of the older Date and Calendar classes by providing better clarity, time-zone handling, and ease of use.

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9. What are intermediate and terminal operations in streams? Provide examples.
Answer: Intermediate operations (e.g., filter, map, sorted) return a new stream and are lazy—they're not executed until needed. Terminal operations (e.g., collect, forEach, reduce) trigger the processing of the stream pipeline and produce a result or side effect.

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10. How does Java 8 enable behavior parameterization using functional programming constructs?
Answer: By treating functions as first-class citizens, Java 8 lets you pass behavior (via lambda expressions or method references) as parameters to methods. This promotes a more modular, flexible, and reusable code design.

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11. Describe the roles of built-in functional interfaces such as Predicate, Function, Consumer, and Supplier.
Answer:

- **Predicate<T>:** Tests a condition on a value and returns a boolean.
- **Function<T, R>:** Transforms an input of type T into a result of type R.
- **Consumer<T>:** Performs an operation on a given argument without returning a result.
- **Supplier<T>:** Provides instances of a given type, useful for deferred execution.

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12. How do default methods in interfaces enhance Java 8's capabilities?
Answer: Default methods allow interfaces to provide an implementation for a method. This enables interface evolution without breaking existing implementations, effectively supporting multiple inheritance of behavior.

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13. What distinguishes static methods in interfaces from default methods?
Answer: Static methods in interfaces belong to the interface itself and cannot be overridden by implementing classes. They are used for utility purposes related to the interface, unlike default methods, which can be inherited and optionally overridden.

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14. How is the forEach method used with streams and collections?
Answer: The forEach method accepts a lambda expression and performs an action for each element of the stream or collection. While it simplifies iteration, using it on parallel streams may lead to non-deterministic ordering.

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15. How does the map operation differ from the flatMap operation?
Answer: The map operation transforms each element in a stream into another object. In contrast, flatMap transforms each element into a stream and then flattens all resulting streams into one, which is useful for handling nested data structures.

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16. How are checked exceptions handled in lambda expressions?
Answer: Since lambda expressions must conform to the abstract method's signature (which typically doesn't allow checked exceptions), you can handle them by wrapping the code in a try-catch block, rethrowing as an unchecked exception, or using helper methods to manage the exceptions.

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17. What is the purpose of the reduce operation, and when would you use it?
Answer: The reduce operation aggregates stream elements into a single result by repeatedly applying a binary operator. It is ideal for tasks such as summing numbers or concatenating strings, and it supports both identity-based and non-identity-based reduction.

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18. What is a Collector in the context of Java 8 streams? Provide an example.
Answer: A Collector is used in the terminal operation collect to accumulate stream elements into a mutable container (like a List, Set, or Map). For instance, Collectors.toList() gathers elements into a List, and Collectors.groupingBy() can group elements based on a classifier function.

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19. How do lambda expressions contribute to performance improvements in Java 8?
Answer: Lambdas eliminate the overhead of anonymous inner classes, allow the compiler to inline code for better optimization, and integrate seamlessly with streams for lazy evaluation and parallel processing, which can significantly enhance performance on large datasets.

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20. What are the potential pitfalls when using parallel streams?
Answer: Parallel streams can lead to issues such as thread-safety concerns, unpredictable execution order, increased overhead for small datasets, and complications with stateful operations. They require careful use, especially in environments where order and thread interference matter.

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21. How can you design an immutable object in Java 8?
Answer: An immutable object can be created by making all fields final, not providing any setters, and ensuring that any mutable objects passed to the constructor are defensively copied. This ensures that the state cannot change after construction.

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22. What is target typing in the context of lambda expressions?
Answer: Target typing is the compiler's ability to infer the type of a lambda expression based on the context (i.e., the expected functional interface type). This feature reduces verbosity by eliminating the need to explicitly specify parameter types.

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23. How does Java 8 resolve conflicts when a class implements two interfaces with the same default method?
Answer: If a class implements two interfaces that define a default method with the same signature, the compiler forces the class to override the method to resolve the conflict. This explicit override determines which behavior is desired.

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24. In what ways do Java 8 streams support parallel processing of collections?
Answer: Java 8 streams can be converted into parallel streams using the parallel() method. This divides the stream's data into multiple substreams processed concurrently by the Fork/Join framework, leveraging multi-core processors for improved performance.

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25. What are some best practices when using Java 8 features in production code?
Answer: Best practices include:

- Keeping lambda expressions clear and avoiding overly complex logic.
- Minimizing side effects in streams to prevent unpredictable behavior.
- Carefully handling exceptions in lambdas.
- Testing parallel streams for thread-safety and performance implications.
- Ensuring that new interface methods (default/static) do not break existing implementations.