
Core Java 8
Lesson 21 : Stream API
Capgemini

## Lesson Objectives

After completing this lesson, participants will be able to

- Understand concept stream API
- Use stream API with collections
- Perform different stream opeations

This lesson covers new feature in Java 8, Stream API . It also covers processing collections using stream API .

Lesson outline:

21.1: Introduction
21.2: Stream API with Collections
21.3: Stream Operations
214: Best practices


Collections API in Java mainly focuses on storage and retrieval of its elements. Many times there is need to perform advanced retrieval operations. For example, Consider a collection of employees and the required operations to be performed:

1. Find the employees having age > 35
2. Group the employees based on their verticals and count.
3. and many more….

How many times do you find yourself re-implementing these operations using loops over and over again?

21.1: Introduction to Streams API

## Why Stream API?

Stream API allows developers process data in a declarative way.
Streams can leverage multicore architectures without writing a single line of multithread code
Enhances the usability of Java Collection types, making it easy to iterate and perform tasks against each element in the collection
Supports sequential and parallel aggregate operations

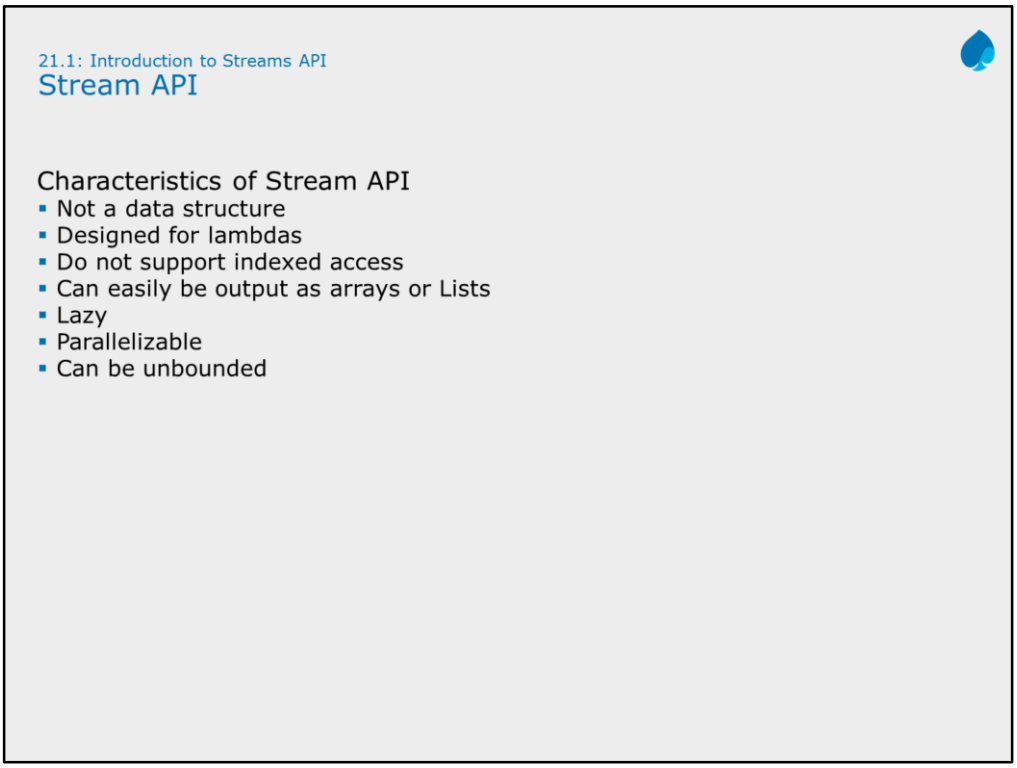
**Stream API**

Stream API to rescue

Streams follow the “what, not how” principle. While working with Stream API, as a developer, we only need to specify what needs to be done.

Stream can be sequential or parallel. A parallel stream is especially useful if the computer the program is running on has a multicore CPU.

The main reason for using a stream is for its supports for sequential and parallel aggregate operations. It allows developer to traverse over a collection of elements and perform aggregate operations, pipeline two or more operations, perform parallel execution, and more.




Stream API Characteristics

Not a data structures:
Streams have no storage. They carry values from a source through a pipeline of operations. They also never modify the underlying data structure.

Designed for lambdas
All Stream operations take lambdas as arguments

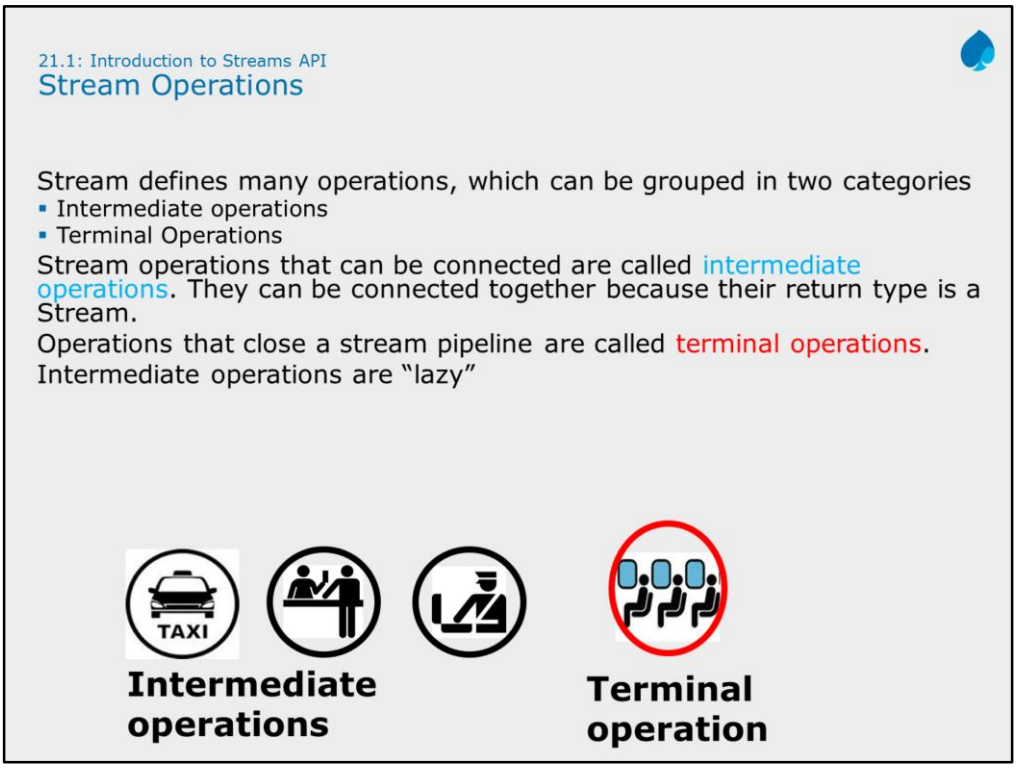
Do not support indexed access
You can ask for the first element, but not the second or third or last element.

Can easily be output as arrays or Lists
Simple syntax to build an array or List from a Stream

Lazy
Many Stream operations are postponed until it is known how much data is eventually needed E.g., if you do a 10-second-per-item operation on a 100 element list, then select the first entry, it takes 10 seconds, not 1000 seconds.

Parallelizable
If you designate a Stream as parallel, then operations on it will automatically be done concurrently, without having to write explicit multi-threading code

Can be unbounded
Unlike with collections, you can designate a generator function, and clients can consume entries as long as they want, with values being generated on the fly

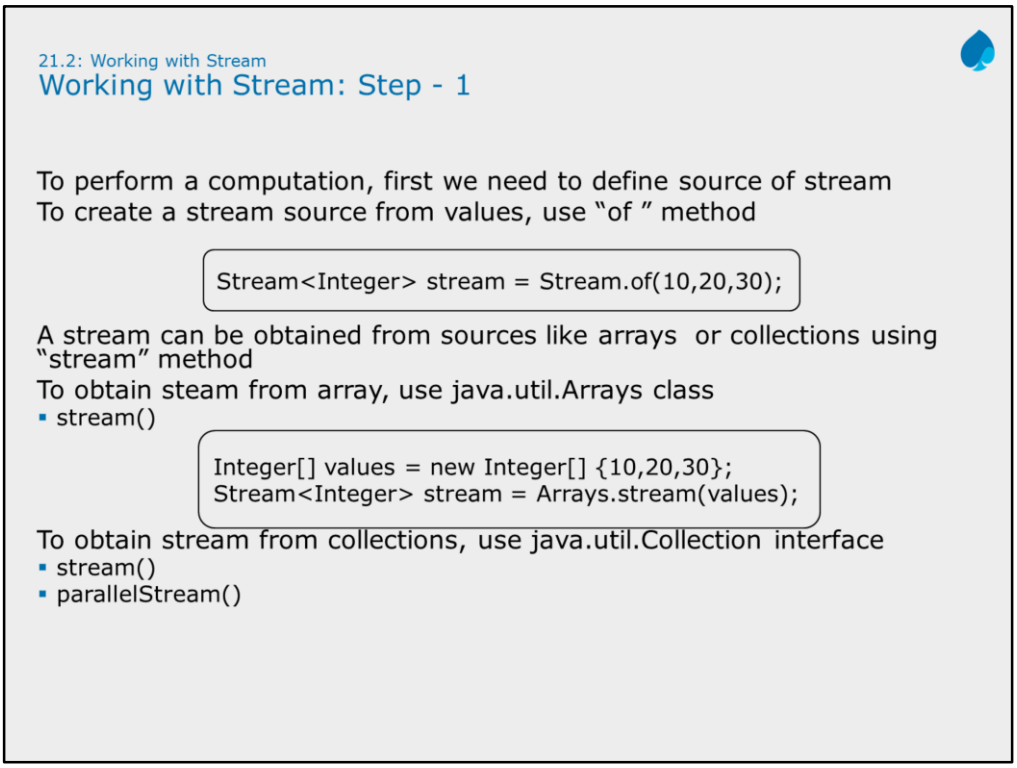



Stream Operations

Some of the Stream methods perform intermediate operations and some others perform terminal operations.

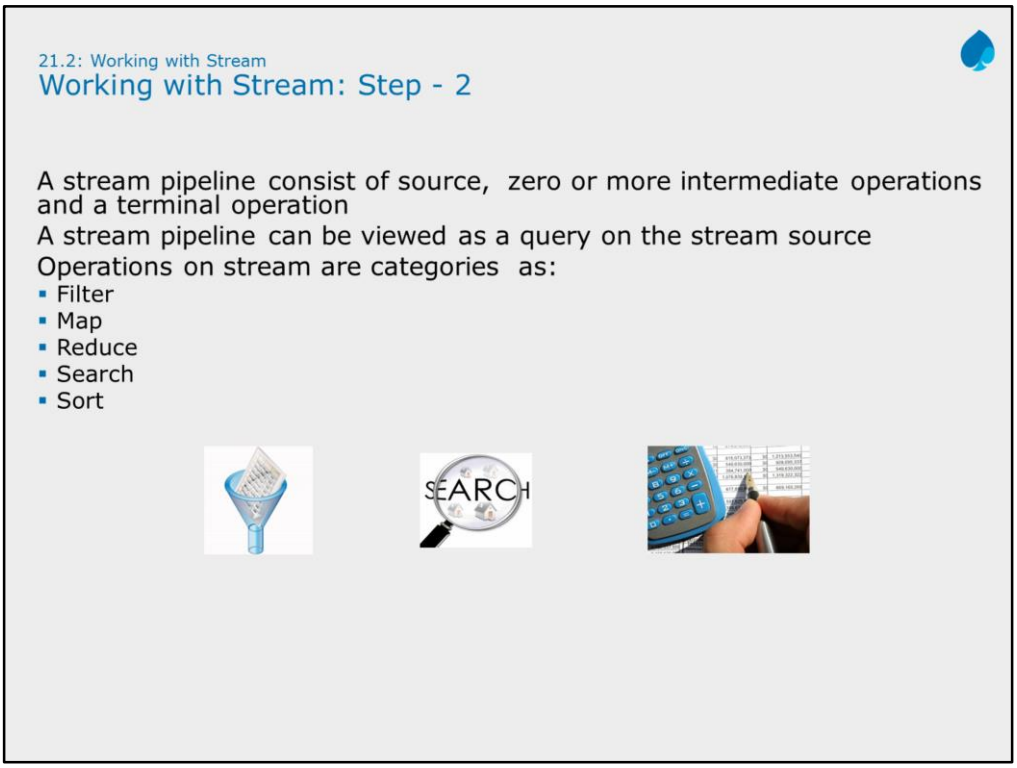
Intermediate operations do not perform any processing until a terminal operation is invoked on the stream pipeline.

As shown in the slide, lets consider you want to travel by air which involves series of operations. Few of them are intermediate operations like travelling by taxi, take ticket from ticket counter, do check-in and finally you do terminal operations which is boarding the plane. The plane doesn't fly during the intermediate operations cause intermediate operations are lazy !




Working with Stream: Step – 1

As stream doesn't store data, we need to define the source to perform stream operations. This is done by either creating stream or obtaining stream from array/collections.

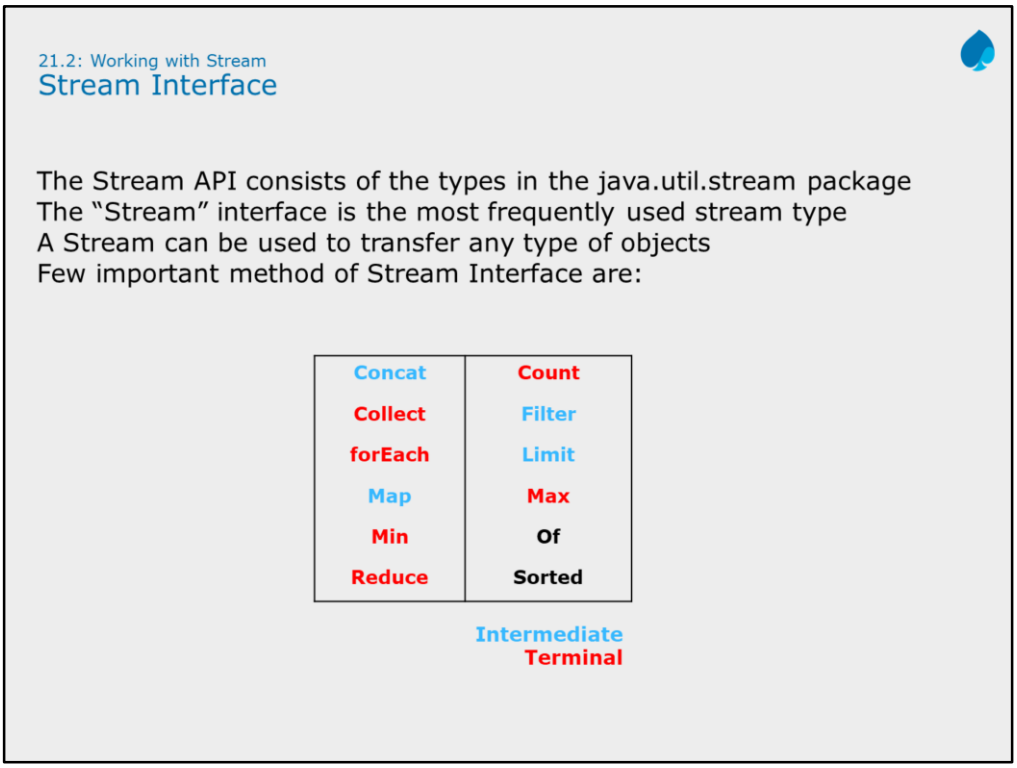



Working with Stream: Step – 2

After obtaining stream we can perform different operations on streams which are categorized into:

Filter
Map
Reduce

Kindly note a steam pipeline may consist of zero or more intermediate operations but it need only one terminal operation. A stream pipeline after terminal operation is closed automatically, hence its not available for further processing. A stream implementation may throw IllegalStateException if it detects that the stream is being reused.




Stream API

Stream API introduced in Java 8 and provided under package java.util.stream. The Stream interface is most frequently used type in Stream API. The slide list few important method of the Stream Interface.

Methods such as filter, map and sorted are examples of methods that perform intermediate operations.

Methods such as count and forEach perform terminal operations.

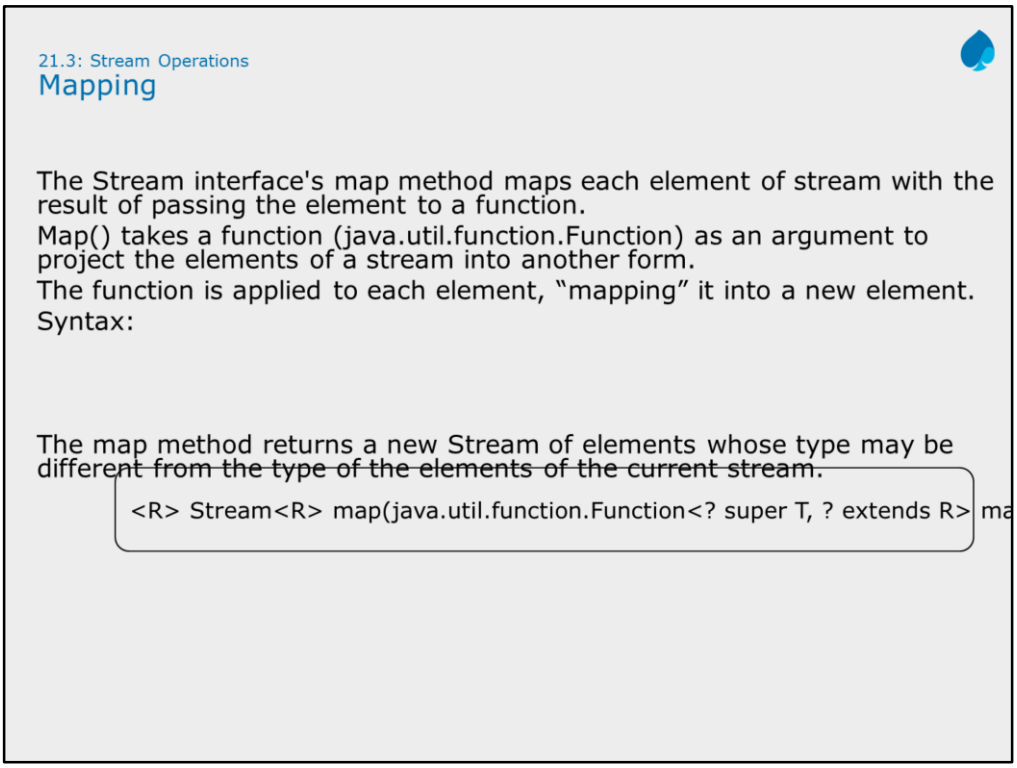
An intermediate operation always returns a stream, where as the terminal operations performs an action.

21.2: Working with Stream

## Demo

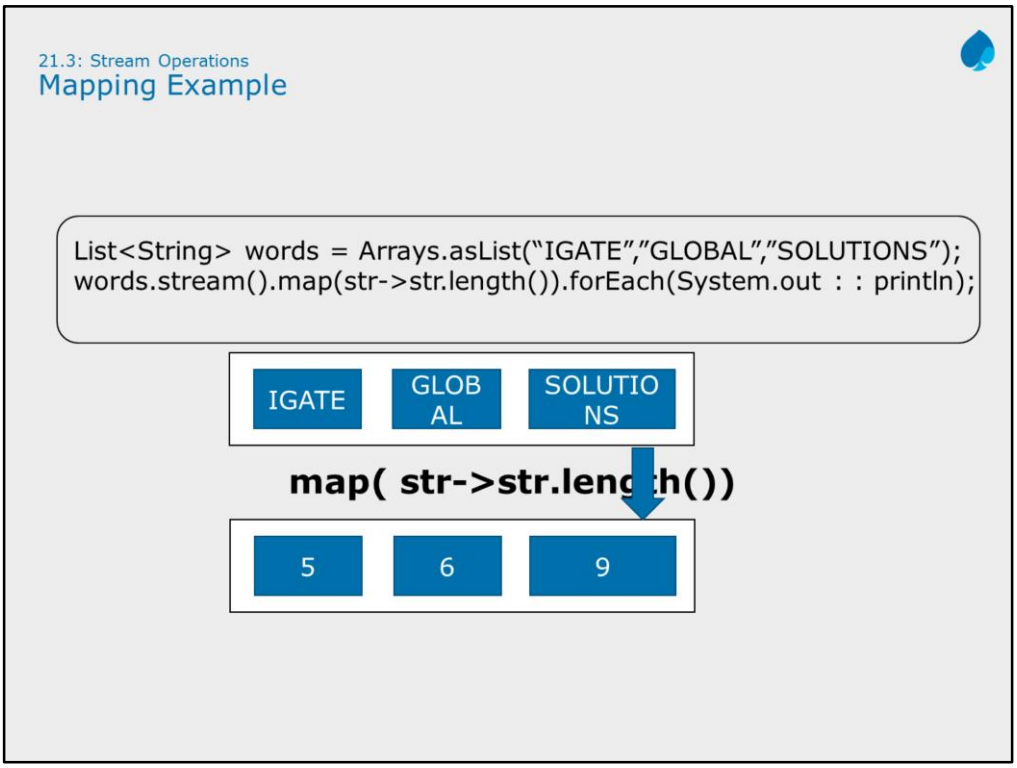
Execute the :

- BasicStream




Mapping

Map method maps each element of stream with the result of passing the elements to a function.




The mapping method returns a new stream of elements which may be different type. Here as shown in the slide example, the words stream is mapped based on length of each element. Therefore it returns a new stream of same size but the element type is integer.

Note: After any intermediate operation on stream, the processed items in resultant stream can be collected in separate collection if required.

```
List<String> words = Arrays.asList("IGATE","GLOBAL","SOLUTIONS");
List<Integer> counts = words.stream()
                                .map(str->str.length())
                                .collect(Collectors.toList());
```

21.3: Stream Operations

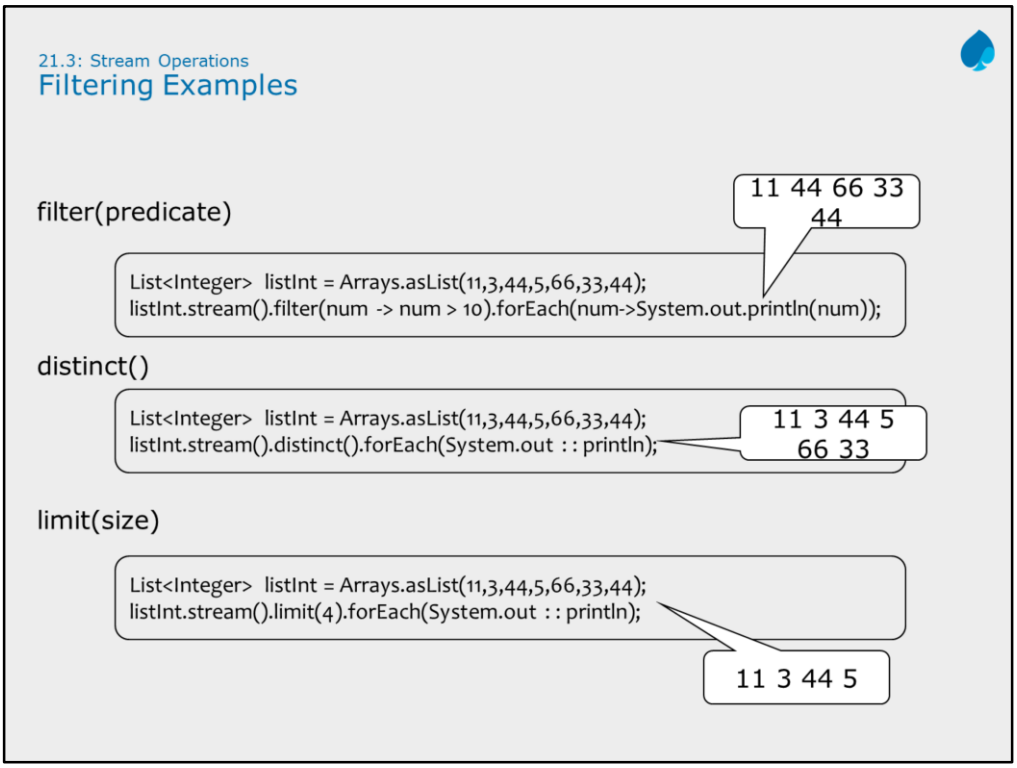
## Filtering

There are several operations that can be used to filter elements from a stream:

| Operation | What ? |
|---|---|
| filter(Predicate) | Takes a predicate (java.util.function.Predicate) as an argument and returns a stream including all elements that match the given predicate |
| distinct | Returns a stream with unique elements (according to the implementation of equals for a stream element) |
| limit(n) | Returns a stream that is no longer than the given size n |
| skip(n) | Returns a stream with the first n number of elements discarded |

Filtering

A stream can be filtered out by using filter() method on Stream interface. Its takes predicate as argument which is usually a criteria for filtering, and returns new filtered stream containing elements which satisfies the criteria.




As shown in the slide examples, the filer operation filters a stream and reduces elements which less than 10.

The distinct() method removes duplicate from the stream.

The limit() method takes the new size of stream as argument and reduces the stream.

Note: All these operations are intermediate operations, whereas the forEach is terminal operation.

21.3: Stream Operations

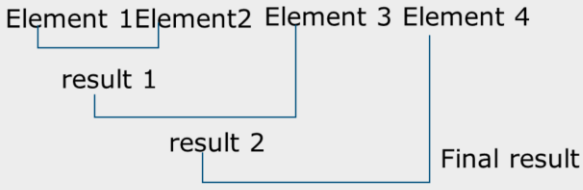
## Reducing

The reduce operation on streams, which repeatedly applies an operation on each element until a result is produced.
It's often called a fold operation in functional programming
Syntax:

The reduce(

java.util.Optional<T> reduce(java.util.function.BinaryOperator<T> accumulator))

method takes a BinaryOperator as argument and returns an Optional instance



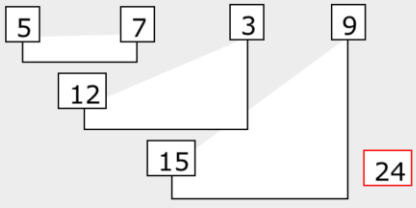
21.3: Stream Operations

## Reducing Example

```
List<Integer> intList = Arrays.asList(5,7,3,9);
Optional<Integer> result = intList.stream().reduce((a,b)->a+b);
if(result.isPresent()) {
        System.out.println("Result:"+result.get());
}
```

Reduction of elements by adding them

Result: 24



21.3: Stream Operations

## Demo

Execute the :

- StreamMap
- StreamFiter
- StreamReduce

21.5: Stream API
## Lab

Lab 11: Lambda Expressions and Stream API

# Summary


- In this lesson, you have learnt:
  - Working with Stream API
  - Using Stream Operations on Collections

## Review Question

Question 1 : Which of the following stream reduce call is valid to find max of given stream?

- **Option 1 :** stream.reduce((a,b)->a>b?a:b)
- **Option 2 :** stream.max()
- **Option 3 :** stream.map((a,b)->a>b)

Question 2 : _____ is a pipe for transferring data.

Question 3 : Resource-intensive tasks can be done efficiently by using parallel stream.

- True/False