==>Java 8-11

==>Reactive Programming (Spring)

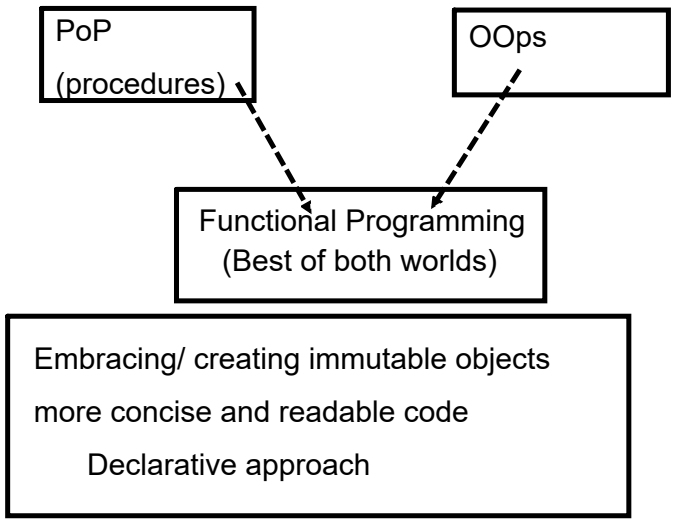
java 1.5 Functional Programming

java 1.8

==> Technological advancement : mobile/laptops/system

Java new feature simplifies concurrency operations

Functional Programming:



Traditional : Imperative

=> Focus on how to perform

=> Object mutability

Declarative Style:

=>Focus on what result we want

=>Object immutability

=>Analogous to SQL (use of already existing part of library to achieve an objective)

Improvisation on interface:

default method

static method

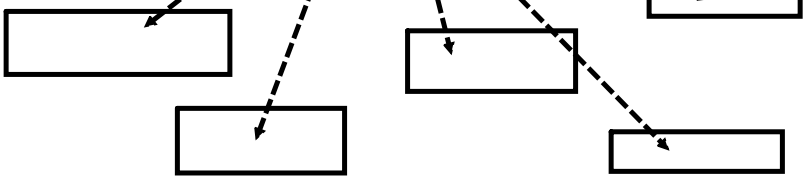
Demand from developer community :

#provision to add new functionality at the top without breaking existing API

interface exists at top level

10 functionality + 2

eg : Stream feature req to be added in existing collection api



Functional Interface : Lambda

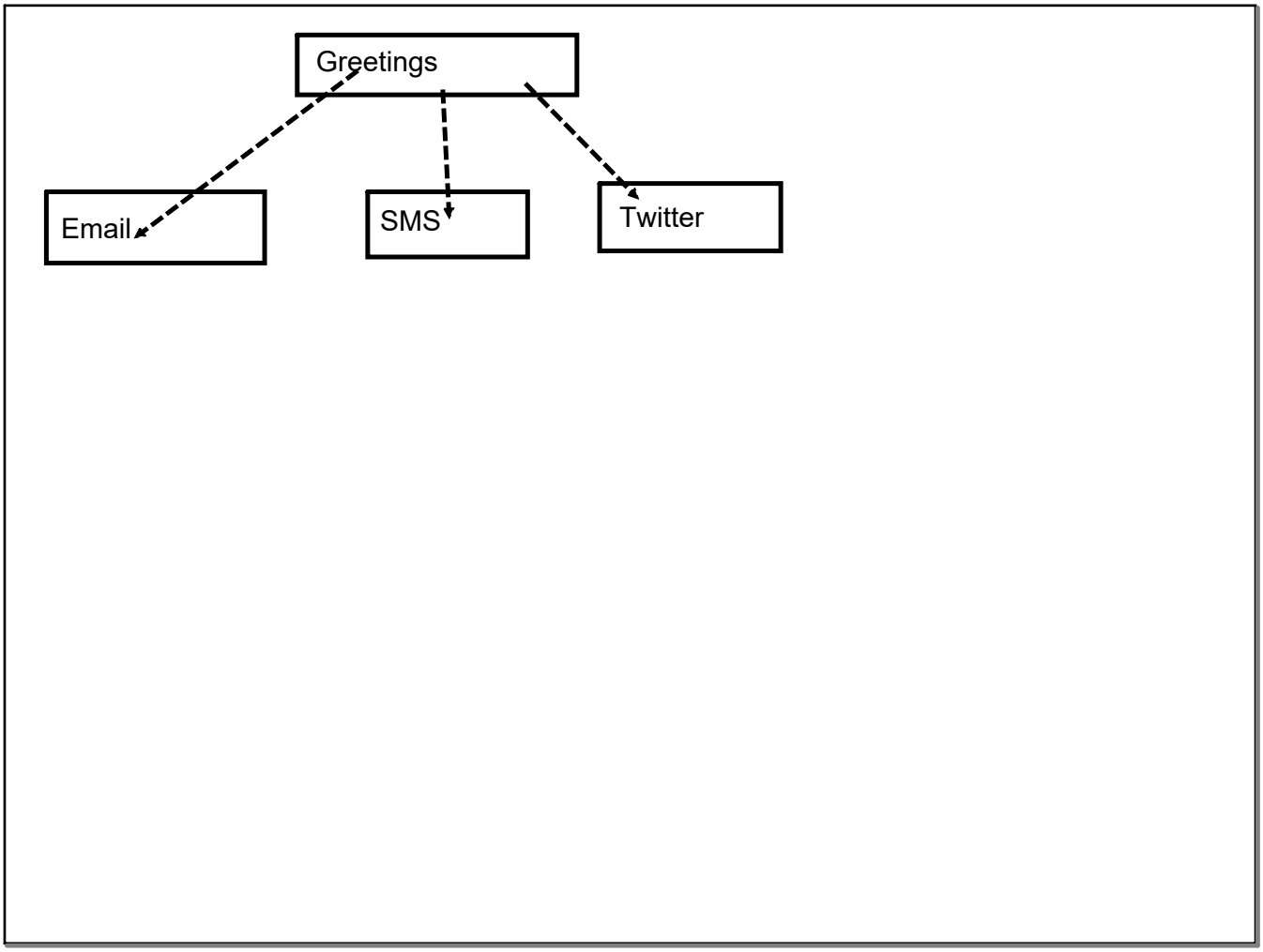
Contains only one abstract method

might have static method, default method (in any count)

jdk1.8 : special annotation

@FunctionalInterface (Compile time)/ optional

would restricts addition of any more abstract method


Greetings
Email
SMS
Twitter

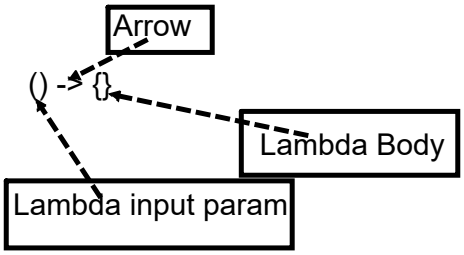
Interface can now act as a <Function type>

1. Functional Interface
2. Function definition that its reference is going to hold must match the prototype only abstract method inside it

Lambda expression:

1. anonymous function
2. method param, method body, return spec
3. Not encapsulated under any class
4. can be assigned to a variable, can be passed around

Lambda expression syntax : Compact



no class implementation

no object management

saved lots of runtime overheads

```
(msg) -> {}
msg -> {} // if single param no need to bind in para
(msg, other) -> {} // multiple, it is necessary
() -> {} // if no param
msg -> single instruction // no need to bind in braces
(a,b) -> a+b // return a+b
// if no braces then single stmt is by default associated with return
```

Functional Interface : (SAM)

=>Runnable

=>Comparator

```
interface Runnable{
    void run()
}

interface Comparator<T>{
    int compare(T o1, T o2);
}
```

New Functional Interfaces of Java 8

Lambdas connect themselves with specific signature

Java 8 has been introduced with group of
functional interfaces containing some very common prototype method
Usage of them has been updated in existing APIs

java.util.function

Consumer : BiConsumer, <Primitive type implementation>

Predicate : BiPredicate, <Primitive type implementation>

Function : BiFunction, UnaryOperator, BinaryOperator

Supplier

Consumer interface :

Single abstract method

void accept(<T>)

BiConsumer interface :

Single abstract method

void accept(<T>, <M>)

Chaining :

Almost all functional interface has chaining facility

#connect multiple implementations of same interface

default / static

Predicate

Single abstract method

boolean test(<T>)

Chaining :

and

or

negate

Function

only abstract method

<R> apply(<T>)

Chaining

andThen()

compose();

BiFunction

R apply(T1, T2)

UnaryOperator:

extension of Function interface

passing param type and

return value type is same

BinaryOperator:

extension of BiFunction interface

passing 2 param type and

return value type is same

2 static methods of BinaryOperator

both returns a lambda ref, which when called will return the max/min values

maxBy(<Comparator>)

minBy(<Comparator>)

Supplier FunctionalInterface

only abstract method

<T> get();

No chaining methods available...

1.. Predicate that can filter on variable value

Function functional implementation : return back such predicate

Method References

simplifies the implementation of Functional interfaces

Shortcut for writing lambda expression

=> to use already existing methods as lambdas

Syntax:

ClassName :: instance-method name

ClassName :: static-method name

instance :: method-name

1. WE are able call instance method through class name (conflict : not allowed all times)
2. method reference not matching the method signature of consumer is still valid

```
Student :: printAllActivities; Shortcut of writing lambda
(recieve an object of type Student

student -> student.printAllActivities();
```

Any instance when called, is automatically passed the instance of that class

printAllActivities(<Student>)

Constructor Reference

Constructors can also represent a lambda

Constructor are expected to return a instance

---

default methods

Custom class , we need to have a custom comparision for sorting

Pre JDK 8 :

create an implementation of Comparator, inject that comparator instance

JDK 8 : special comparator default method that can allow to inject comparision criteria

(Functional) Interface are more like Abstract Classes

direct instance related feature could not be defined

==> Multiple Inheritance in interface

JDK 8 allows to multiple inherit functionalities

Stream

Lambdas and Local Variables

Local Variable : declared inside any method

Lambdas have some restrictions on using local variables

=> Lambda expressions are not allowed to use the same name as

local variable as param or even inside lambda body for redeclaration

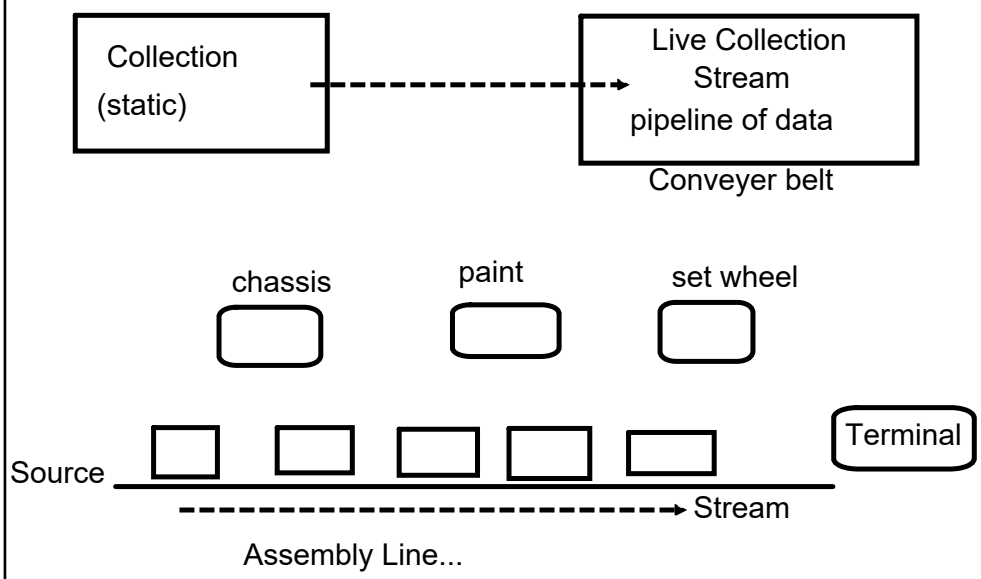
but can use it

(No restriction on class variables)

=> local variable are effectively final (no need to use final keyword)

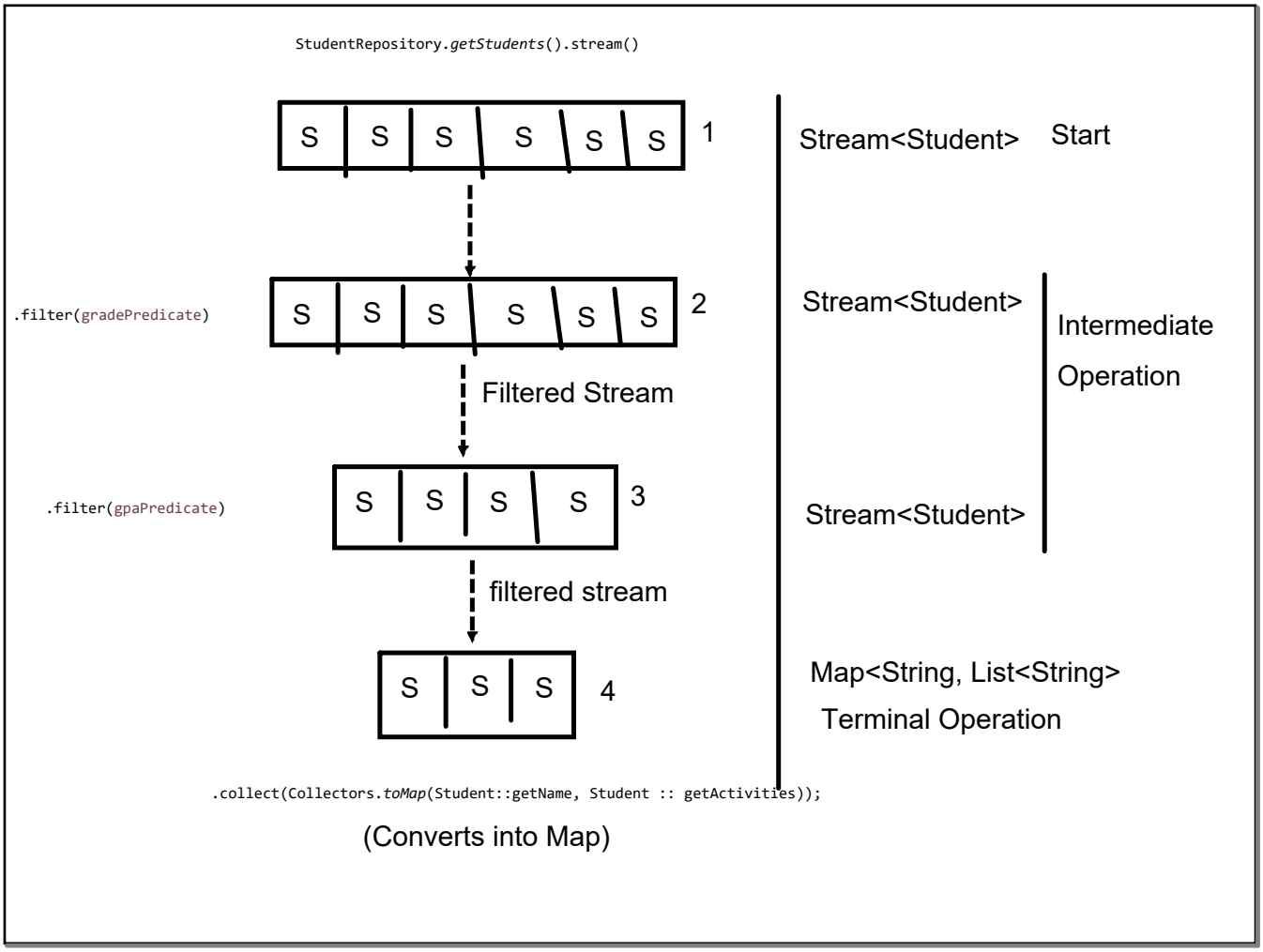
conditionally effectively final

Stream : can be created out of a Collection (warehouse), I/O



```
List<String> names = Arrays.asList('First', 'Second','Third');
names.stream(); // creates a stream
sequential or parallel
names.parallelStream(); // creates a Parallel stream
```

Collection	Stream
Add or modify any element of collection	Works on immutable/ fixed set of data
Elements can be accessed in any order	Elements can be accessed in a sequence
Collections can be traversed n number of times	Streams can traversed only once (one set of activities at a time)
External iterations	Internal Iteration
Collections are eagerly constructed	Streams are lazily constructed (will going to take place only if terminal operation ia available)


StudentRepository.getStudents().stream()
S S S S S S
1
Stream<Student>
Start
.filter(gradePredicate)
S S S S S S
2
Stream<Student>
Intermediate
Operation
Filtered Stream
.filter(gpaPredicate)
S S S S
3
Stream<Student>
filtered stream
S S S
4
Map<String, List<String>
Terminal Operation
.collect(Collectors.toMap(Student::getName, Student :: getActivities));
(Converts into Map)

Stream methods

=>Intermediatory Operation

=>Terminal Operation

Debug the stream : look into conveyer belt : peek()

Stream API : map()

Convert/Transform

flatMap():

like map : transform

used in context where each element in the stream represents multiple elements

Eg:

Stream<List>

Stream<Array>

Flatten the stream (non-nested stream) and transform

distinct() : Returns a stream with unique elements

count() : Returns a long: total no of elements in Stream (terminal activity)

sorted() : sort the elements of stream

filter(<Predicate>) : filters the elements of streams

reduce() : reduces the contents of stream into single value

(terminal operation)

ask for 2 param

1. default/ initial value
2. BinaryOperator

==> Collect the elements of stream and performs some operation(inject through BinaryOperator). Activity performed on two element at a time, thus reducing all element into single value

Student Repository:

Extract the record of a student having highest gpa

Stream API : create sub-stream

limit(n) : it generate a sub-stream containing only first n elements

skip(n) : skip first n element and generate a sub-stream

Match methods: (terminal method)

input : a predicate

output : boolean

anyMatch() : return true if any one of the element matches the predicate

allMatch() : return true if all of the element matches the predicate

noneMatch(): return true if none of the element matches the predicate

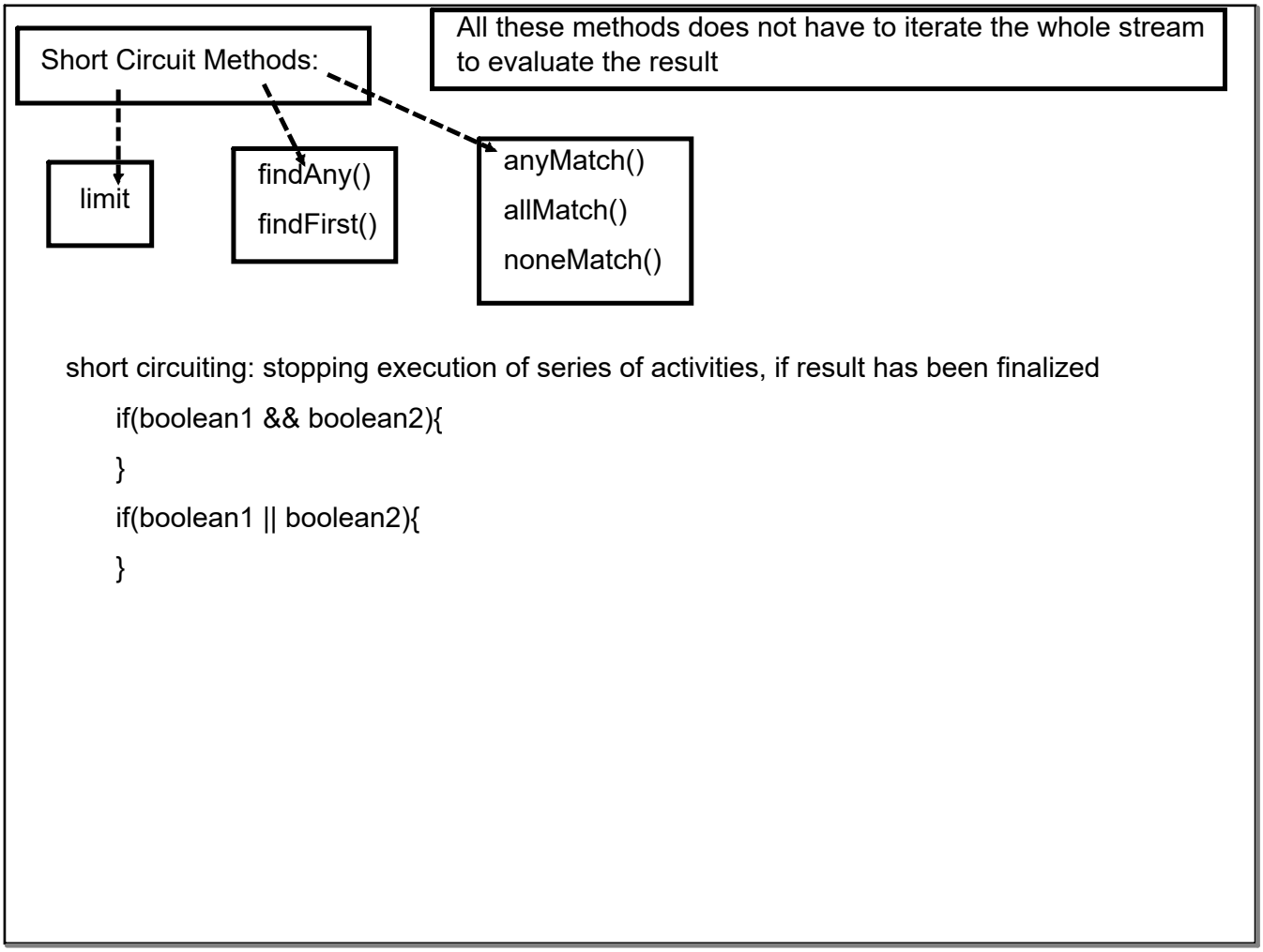
Find Method: (terminal Operation)

#Used to find an element in stream

#returns element as Optional

findFirst() : Returns the first element of stream

findAny() : Returns the first encountered element in stream (parallel)



short circuiting: stopping execution of series of activities, if result has been finalized

```
if(boolean1 && boolean2){
}
if(boolean1 || boolean2){
}
```

Factory method (Stream API : static)

of() : by default stream are generated from standard collection object

Create a stream of certain values passed to this method

Both method create infinite stream

iterate(<starting>,<Function:activity>) :

generate(<Supplier>)

Stream<Integer> number;

Numeric Stream : Represent the primitive values in stream

IntStream

LongStream

DoubleStream

Factory method of numeric stream

IntStream.range(1,50) : return a IntStream(49) 1-49

IntStream.rangeClosed(1,50) : return a IntStream(50) 1-50

==> Similar methods in long stream

==> DoubleStream does not provides range methods

Aggregate method

sum/max/min/average

Regular streams maintain data of primitive values as stream of wrapper object

For every operation on those object un-boxing will be done (overhead)

type specific method/direct/additional

Boxing and Unboxing method for conversion explicitly

Mapping Methods of Numeric Streams (Trasformation)

mapToObj() : Convert each element into an Object

mapToLong()

mapToDouble()

Stream Terminal Operation

they start the whole pipeline

collect the data (shape up the final response)

Eg:

forEach() / min() / max() / reduce/

collect(Collector)

Collector :

==>joining()

==> performs String concatenation

3 overloaded version

==>counting() : returns the total number of elements

==>mapping() : applies the transformation and then collects the data in a collection (any type of collection)

==>Comparision based collectors (works with comparator)

maxBy() :

minBy():

==> numeric based collector

summingint()

averagingint()

==>groupingBy() :

analogous to groupBy of SQL

group elements of stream based on a property

returns : Map<K,V>

==> three overloaded variants

gpa1:list

gpa2:list

groupingBy(classifier)

groupingBy(classifier, downstream Collector)

groupingBy(classifier, Supplier, downstream Collector)

Map : Customization any special variant of Map

Fetch top GPA student in each grade

==> partitioningBy()

    # is is type of groupingBy()

Input : Predicate

Output : Map<k,V>

    Key : boolean

Creates only 2 groups

    1. those elements which satisfies a predicate (true)

    2. those elements which does not satisfies a predicate(false)

2 variant

    partitioningBy(<predicate>);

    partitioningBy(<predicate>,<downstream Collector>);

parallel stream

Splits the source of data in to multiples part, each part being processed parallely

Sequential stream

IntStream.range(1,1000).<activity>()

List<>.stream().<activity>();

ParallelStream:

IntStream.range(1,1000).parallel().<activity>()

List<>.parallelStream().<activity>();

Parallel stream implementation is based on Fork/Join Framework (java7)

Number of thread = number of processor available in machine

Primitive Stream : IntStream / DoubleStream / LongStream

=> boxing-unboxing

Parallel Stream : (CAUTION!!!)

any operation taking place behind the scene is much inefficient in parallel cases

any operation involving mutable object will result into inconsistency in parallel stream

Optional

represent a non-Null value

Avoid Null Pointer Exception (Unnecessary Null Checks)

Inspired from Scala, Groovy

Wrapper around any object, expose method the validate, use, decide on the basis of data available/not-available

Factory Methods

ofNullable()

of()

empty()

Alternate to null methods

- orElse()
- orElseGet()
- orElseThrow()

Confirmation method : confirm the availability of data under optional object

Action method

- map() : Optional
- flatMap() : Optional
- filter() : Optional

New Date/Time Library: java.time.*

Core Classes : LocalDate, LocalTime, LocalDateTime

Joda-Time : most popular third party lib (inspiration behind date/time api)

Instant, Duration, Period, Formatter....(Supportive classes)

Immutable instances

Epoch Time : Midnight of 1st January 1970

Period is a date based representation ~ LocalDate

Does not represent a particular (Period of time)

eg:

Period.ofDays(2000); how many yrs/mth/days

Calculate diff between two dates

Duration

time based representation : hrs/min/sec/nano

Instant : Represents time in machine readable format

Calculated wrt epoch time (seconds)

DateTimeFormatter : java.time.format

parse and format --- all implementation

parse : converting a string to date/time

format : date/time to string
