We are all to gather

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We are all together

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We are all to **gather**

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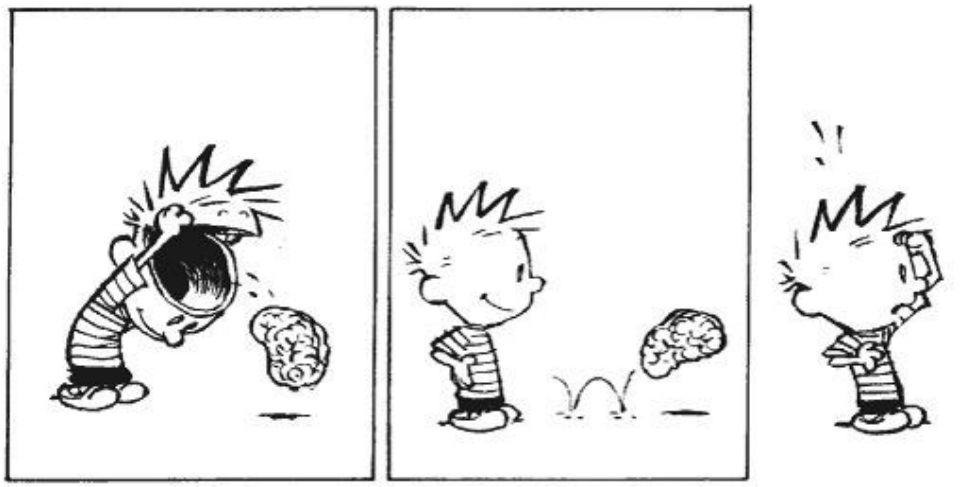


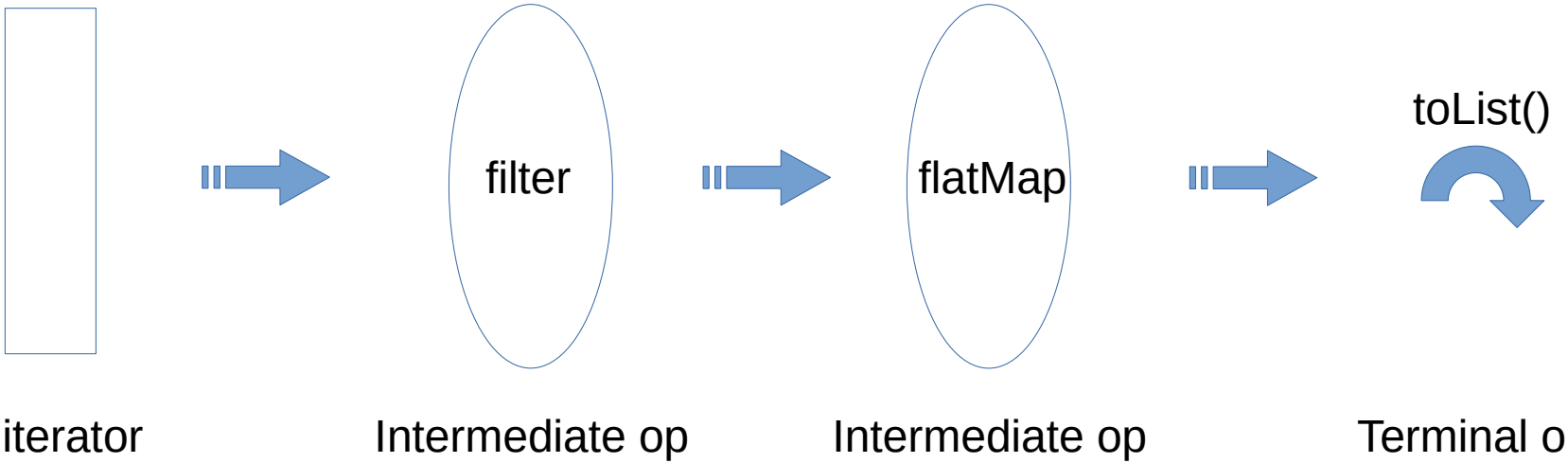
Don’t believe what I’m saying !

Outline

- Stream operations
- The Gatherer API
- Performance and limitations

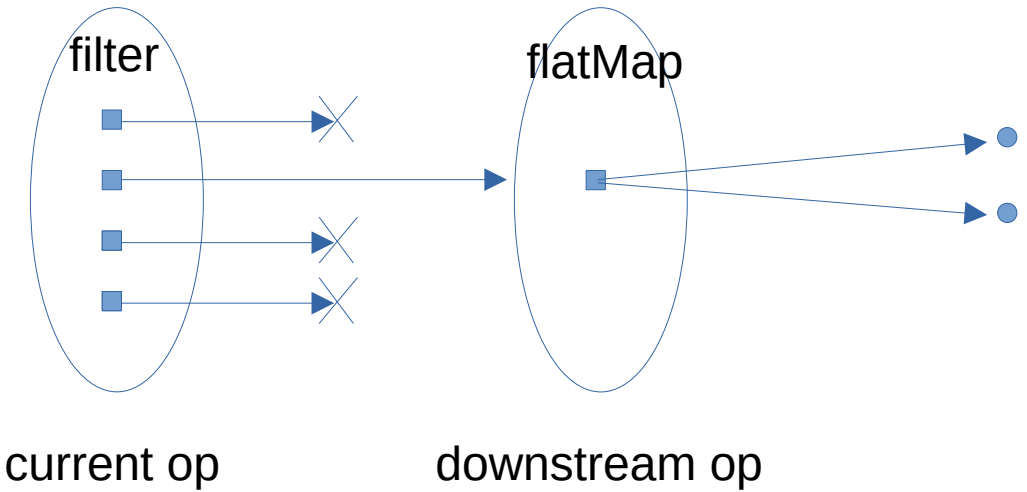
A stream is defined by ...

- a source, abstracted as a Spliterator
- some intermediate operations
- a terminal operation that drives the pipeline



An intermediate operation

- Can be sequential or parallel (findFirst vs findAny)
- May have state (limit, distinct, sorted)
- Can push elements to the downstream op
  (and back-propagate the stop signal)



The Gatherer API

Allow user-defined intermediate operations

```
Gatherer gatherer = …

list.stream()
  .filter(...)
  .gather(gatherer)
  .toList();
```

Like a Collector but for intermediate operations

Intermediate Ops

3 axis

- Can be parallelizable ? sequential/parallel
- Have an internal state ? stateless/stateful
- Can stop the computation ? greedy/short-circuiting

Intermediate Ops (examples)

Operations

- map() ??

Intermediate Ops (examples)

Operations

- map() parallelizable, stateless, greedy
- filter() ??

Intermediate Ops (examples)

Operations

- map() parallelizable, stateless, greedy
- filter() parallelizable, stateless, greedy
- takeWhile() ??

Intermediate Ops (examples)

Operations

- map() parallelizable, stateless, greedy
- filter() parallelizable, stateless, greedy
- takeWhile() sequential, stateless, short-circuit
- limit() ??

Intermediate Ops (examples)

Operations

- map() parallelizable, stateless, greedy
- filter() parallelizable, stateless, greedy
- takeWhile() sequential, stateless, short-circuit
- limit() sequential, stateful, short-circuit
- reduce() ??

Intermediate Ops (examples)

Operations

- map() parallelizable, stateless, greedy
- filter() parallelizable, stateless, greedy
- takeWhile() sequential, stateless, short-circuit
- limit() sequential, stateful, short-circuit
- reduce() parallelizable, stateful, greedy

Live Code !

Gatherer API

Gatherer<E, A, T>

initializer: Supplier<A>

- Create a state

integrator (A state, E element, Downstream<T> downstream) → boolean

- Modify state and/or push downstream (+ back-propagate return type)

combiner: BinaryOperator<A>

- Combine two states, return a new state

finisher: BiConsumer<A, Downstream<T>>

- Push downstream at the end

```
interface Downstream<T> {
  boolean push(T element);
  boolean isRejecting();
}
```

Creating a Gatherer : 3 axis

Sequential only vs Parallelizable

- Gatherer.ofSequential() vs Gatherer.of() + combiner?

Stateless vs Stateful

- integrator vs initializer + integrator + finisher?

Short-circuit vs Greedy

- integrator vs Integrator.ofGreedy()

Performance ?

WARNING ! WARNING !

The stream API relies heavily on the VM being able to correctly propagates type profiles

- If that strategy does not work, the VM records type profiles

There is usually no profile pollution in a micro-benchmark so real world scenario performance may be worst !

Performance (map + sum)

```
public int stream_map_sum() {
  return values.stream().map(String::length).reduce(0, Integer::sum);
}    // 481.222 ±  1.560  us/op

public int stream_mapToInt_sum() {
  return values.stream().mapToInt(String::length).sum();
}    // 102.089 ±  0.672  us/op

public int gatherer_map_sum() {
  return values.stream().gather(map(String::length)).reduce(0, Integer::sum);
}    // 552.384 ±  3.405  us/op
```

No primitive specialization ...

* `values` is a List of 100_000 strings

Performance (map + toList)

```
public List<Integer> stream_map_toList() {
  return values.stream().map(String::length).toList();
}    // 332.322 ±  0.512  us/op

public List<Integer> gatherer_map_toList() {
  return values.stream().gather(map(String::length)).toList();
}    // 558.873 ±  6.200  us/op
```

Why using a Gatherer is slower ? ...

Performance (map + count)

```
public long stream_map_count() {
  return values.stream().map(String::length).count();
}    // 0.009 ±  0.001  us/op

public long stream_mapToInt_count() {
  return values.stream().mapToInt(String::length).count();
}    // 0.009 ±  0.001  us/op

public long gatherer_map_count() {
  return values.stream().gather(map(String::length)).count();
}    // 101.993 ±  0.105  us/op
```

=> spliterator characteristics are not propagated !

Performance issues

No primitive specialization

- mapToInt/flatMapToInt, etc
  - Same issue with collectors
  - Valhalla generics to the rescue ??

Spliterator characteristics are not propagated

- Same issue with collectors
  - For ex: Stream.toList() can presize, not Collectors.toList()

Executive Summary

Gatherer API

User defined intermediary operations

- 3 axis: short-circuitability / statefulness / only-sequential

Gatherers contains predefined Gatherers

Still In preview

- Not enough predefined Gatherers
- Spliterator characteristics should be propagated
- “default operations” design is controversial

Questions ?

https://github.com/forax/we_are_all_to_gather