Using Java Streams to Process and Analyze Data in Memory

USING JAVA STREAMS TO PROCESS AND ANALYZE DATA IN MEMORY

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How to work with the Stream API

- using map / filter / reduce to analyze data
- in memory data processing
- creating Stream
- computing statistics on data
- creating collections
- working with histograms

This is a Java course

- basic knowledge of Java
- basic knowledge of the Collection API
- how to create and run a simple program
- how to write lambda expressions

Java version 8+, 11+

Agenda

First, what is map / filter / reduce

How to implement this in the right way!

How do streams differ from collections

Using Map / Filter / Reduce

Given a list of people

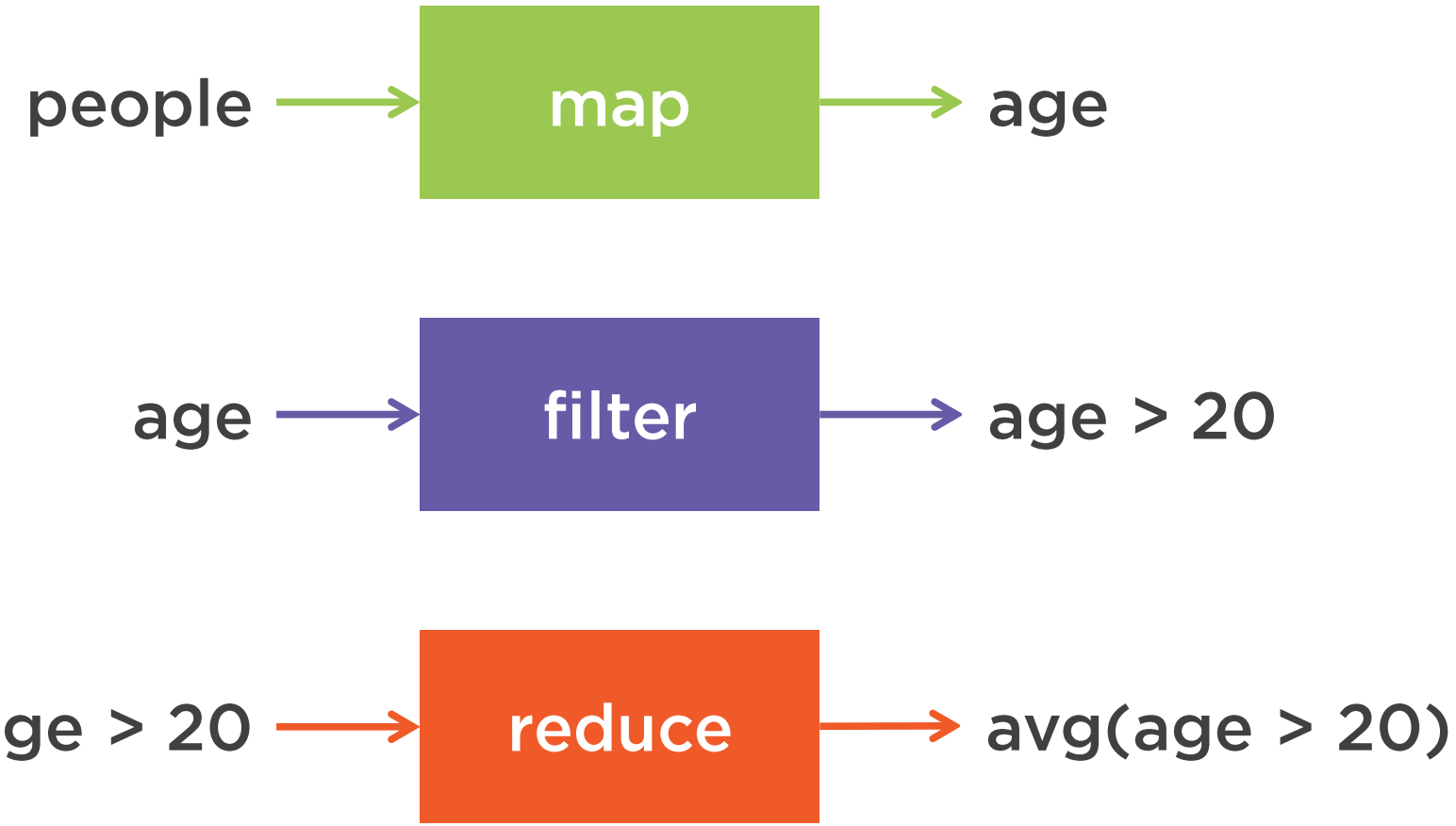
We need to compute the average of the age of those people

For the people older than 20

This classical example is implemented

With a map / filter / reduce approach

Map / Filter / Reduce



Mapping Data

map

`List<Person>` → `List<Integer>`

A mapping changes the type of the data,
does not change the number of elements

Filtering Data

filter

`List<Integer>` → `List<Integer>`

A filtering does not change the type of the data, does change the number of elements

Implementing Map / Filter / Reduce

```java
List<Person> people = ...;

int sum = 0;
int count = 0;

for (Person person: people) {
    if (person.getAge() > 20) {
        count++;
        sum += person.getAge();
    }
}

double average = 0d;
if (count > 0) {
    average = sum / count;
}
```

Classical implementation
using the Iterator pattern

Caveat:

- the code tells how to compute things
- not what to compute

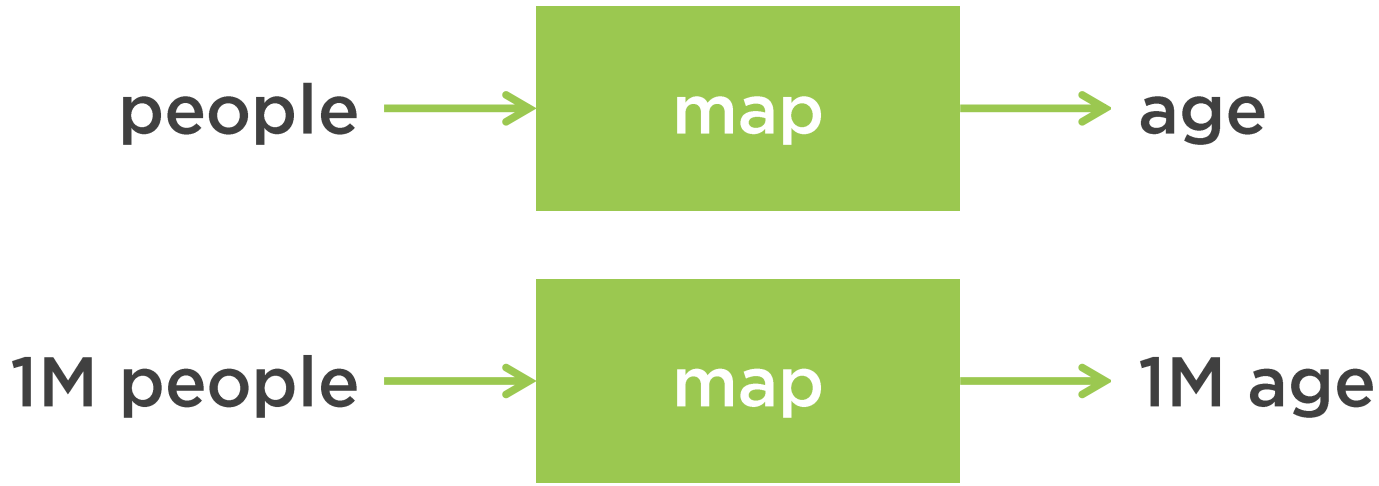
Example is SQL:

```
SELECT AVG(age)
    FROM People
    WHERE age > 20
```

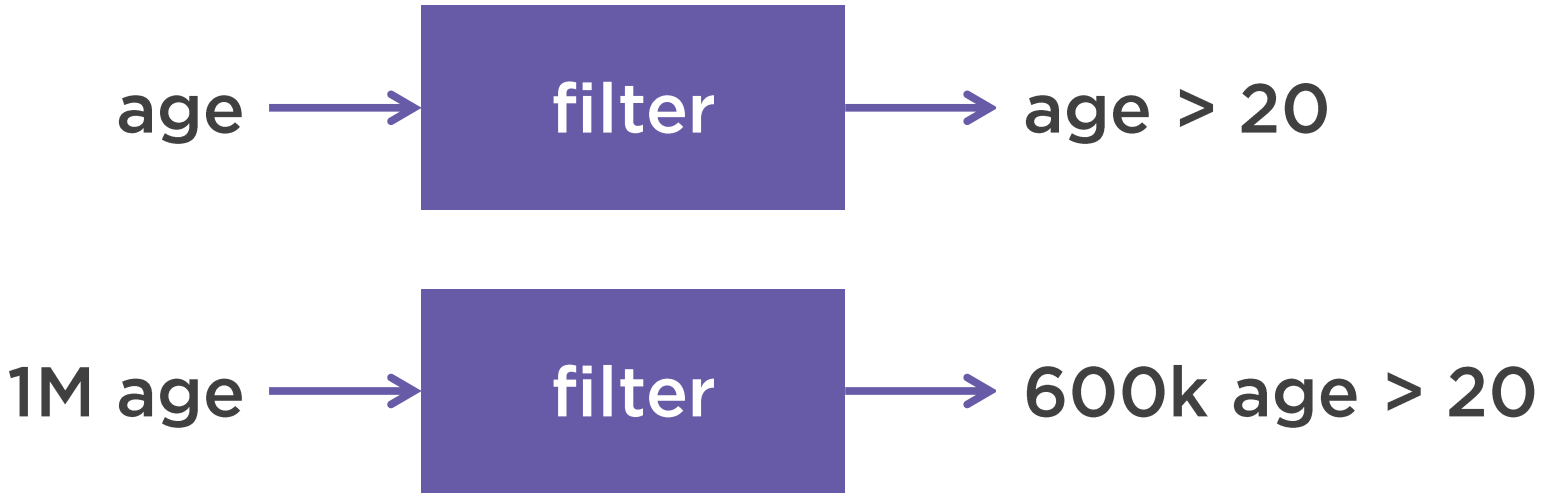
```
List<Person> people = ...;

double average =
    people.map(person -> person.getAge())
          .filter(age -> age > 20)
          .average();
```

What about implementing map / filter / reduce on the Collection API?

Mapping Data



Filtering Data



Should a mapper / filter duplicate the data?

```
List<Person> people = ...;

double average =
    people.map(person -> person.getAge())
          .filter(age -> age > 20)
          .average();
```

What about implementing map / filter / reduce on the Collection API?

Is it a good idea to implement it in that way?

The Collection Framework
is not the right place to implement
map / filter / reduce

```
List<Person> people = ...;

double average =
    people.stream()
          .map(person -> person.getAge())
          .filter(age -> age > 20)
          .average();
```

The Stream API is a concept

- used to implement the map / filter / reduce algorithm
- without duplication

List<Person>: contains the people

person.stream(): returns a Stream<Person>

By construction, a stream is empty

So building a stream is “free”

The Java Stream API
implements map / filter / reduce
without duplicating the data

Working with Java Streams

```
List<Person> people = ...;

people.stream()
      .map(...)
      .filter(...)
      .average();
```

- This is the data

- Creates a Stream<Person>
- Creates a Stream<Integer>
- Creates a Stream<Integer>
- Triggers the computation in one pass over the data

There are two kinds of methods on Stream:

- methods that create a Stream

- methods that produce a result

A method that creates a Stream
is an intermediate method

A method that produces a result
is terminal method

Module Wrap Up

What did you learn?

What is a Java Stream?

An in-memory implementation of the map / filter / reduce pattern

A stream does not carry any data

Intermediate operations

Terminal operations