Victoria University
of Wellington, New Zealand
Te Whare Wananga o te
Upoko o te Ika a Maui
Aotearoa

SWEN221:
Software Development

21: Java 8 (2)

Outline

- Optional
- Streams

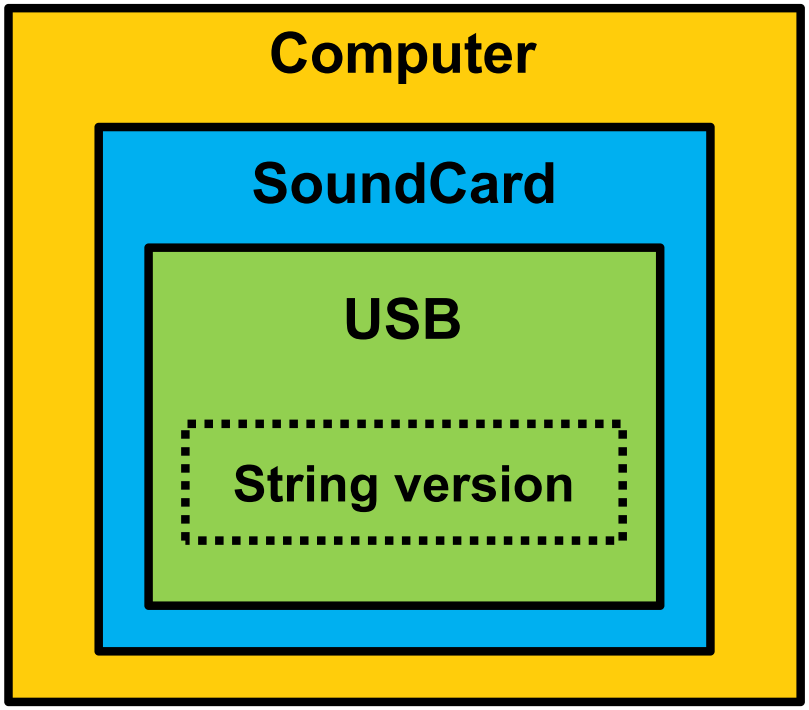
Why Optional?

- Get a `String version` of the `USB` of the `SoundCard` of the `Computer`

```
String ver = computer.getSoundCard().getUSB().getVersion();
```

- Many computers don't have sound card
- Sound card may not have USB

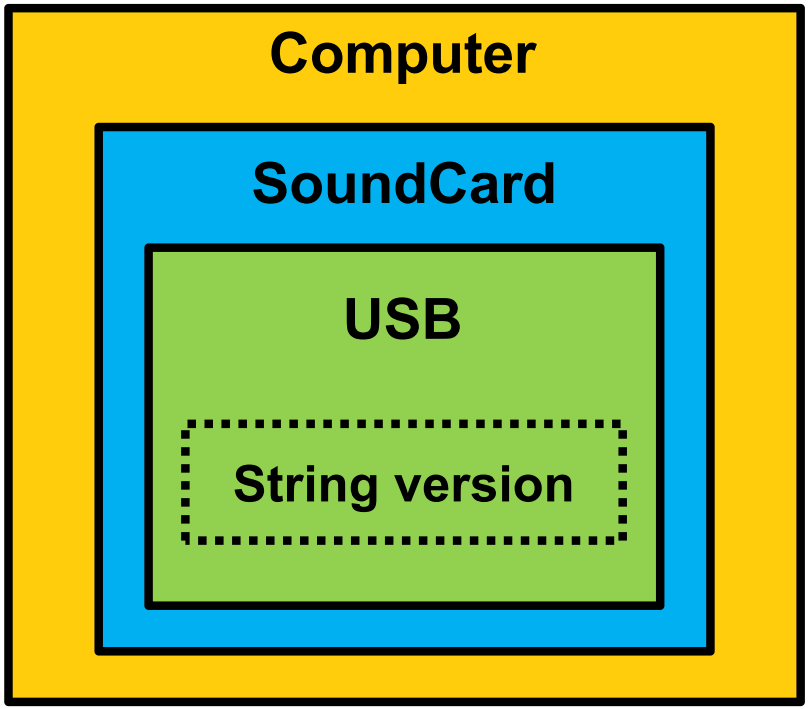
- `NullPointerException()`



Why Optional?

```
String ver = "UNKNOWN";
if(computer != null){
 Soundcard soundcard = computer.getSoundcard();
 if(soundcard != null){
  USB usb = soundcard.getUSB();
  if(usb != null){ ver = usb.getVersion(); }
}}
```

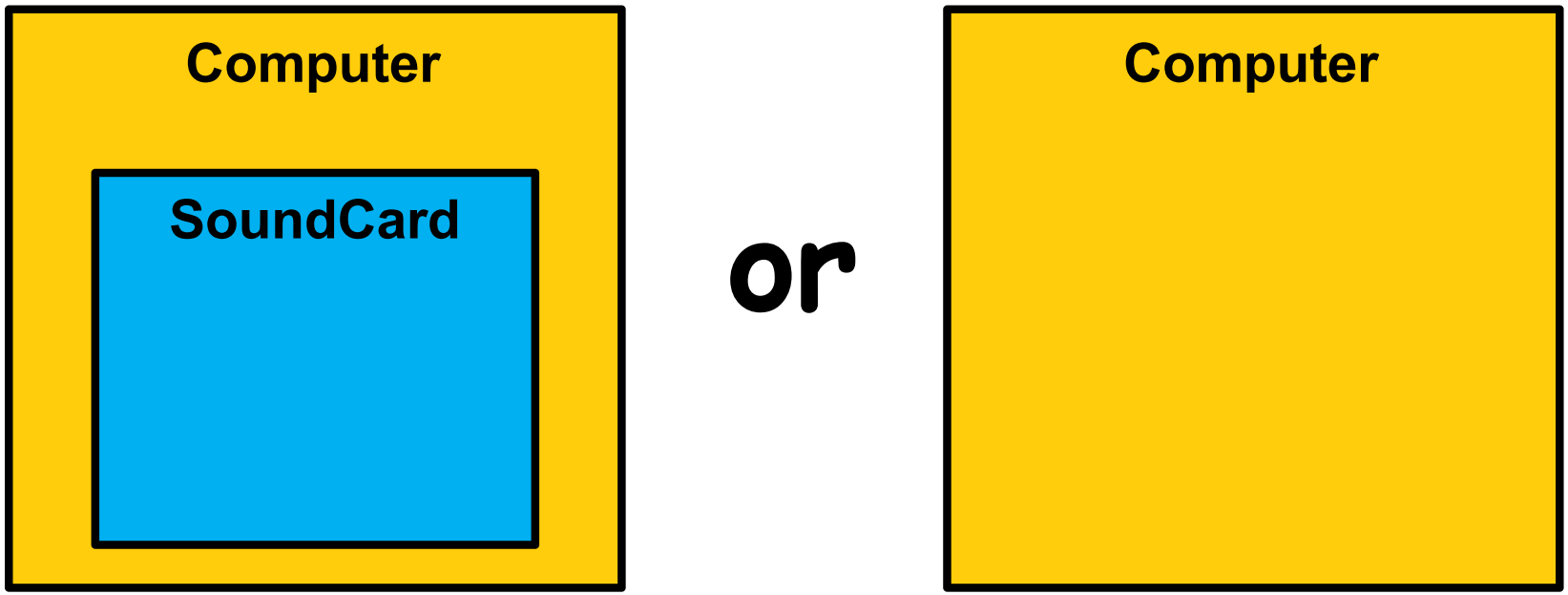
- So many null checks
- Get rid of the ugly code



Optional

- A better alternative to null

```
class Computer {
 private Optional<Soundcard> soundcard;
 public Optional<Soundcard> getSoundcard() {
  return soundcard;
}}
```



Creating Optional

- Empty:

```
Optional<Soundcard> sc = Optional.empty();
```

- From non-null value:

```
Soundcard card = new SoundCard();
Optional<Soundcard> sc = Optional.of(card);
```

- From any value (including null):

```
Soundcard card = …;
Optional<Soundcard> sc = Optional.ofNullable(card);
```

Do Something If Present

- Null check

```
SoundCard card = …;
if (card != null) { System.out.println(card); }
```

- Optional

```
Optional<SoundCard> optCard = …;
if (optCard.isPresent()) {
 System.out.println(optCard.get());
}
```

Default Value If Empty

- `T orElse(T default)`
  - Return the default value if the `Optional` is empty

```
Optional<Soundcard> maybeSoundcard = …;

Soundcard soundcard =
  maybeSoundcard.orElse(new Soundcard("default"));
```

What Will be Printed?

```
class Person {
 public String name;
 public Person(String name){ this.name = name; }
}

Optional<Person> op1 = Optional.ofNullable(null);
Optional<Person> op2 = Optional.of(new Person("Eva"));
Person p1 = op1.orElse(new Person("Allen"));
Person p2 = op2.orElse(new Person("Allen"));

if(op1.isPresent()) System.out.println(p1.name);
if(op2.isPresent()) System.out.println(p2.name);
```

A)
```
Eva
Allen
```

B)
```
Eva
Eva
```

C)
```
Eva
```

D) Cannot compile

What Will be Printed?

```
class Person {
 public String name;
 public Person(String name){ this.name = name; }
}

Optional<Person> op1 = Optional.ofNullable(null);
Optional<Person> op2 = Optional.of(new Person("Eva"));
Person p1 = op1.orElse(new Person("Allen"));
Person p2 = op2.orElse(new Person("Allen"));

if(op1.isPresent()) System.out.println(p1.name);
if(op2.isPresent()) System.out.println(p2.name);
```

A)
```
Eva
Allen
```

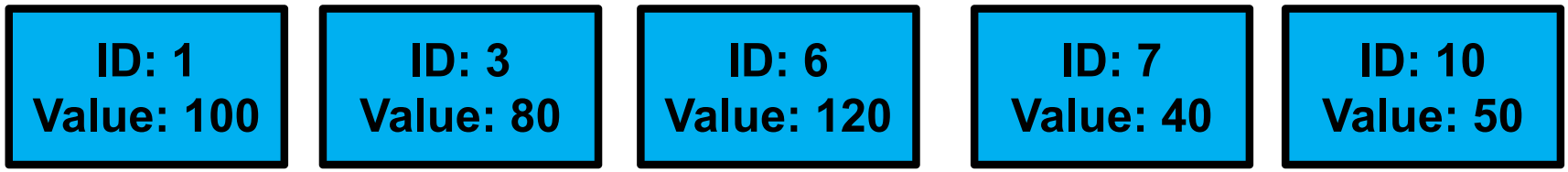

B)
```
Eva
Eva
```


C)
```
Eva
```


D) Cannot compile

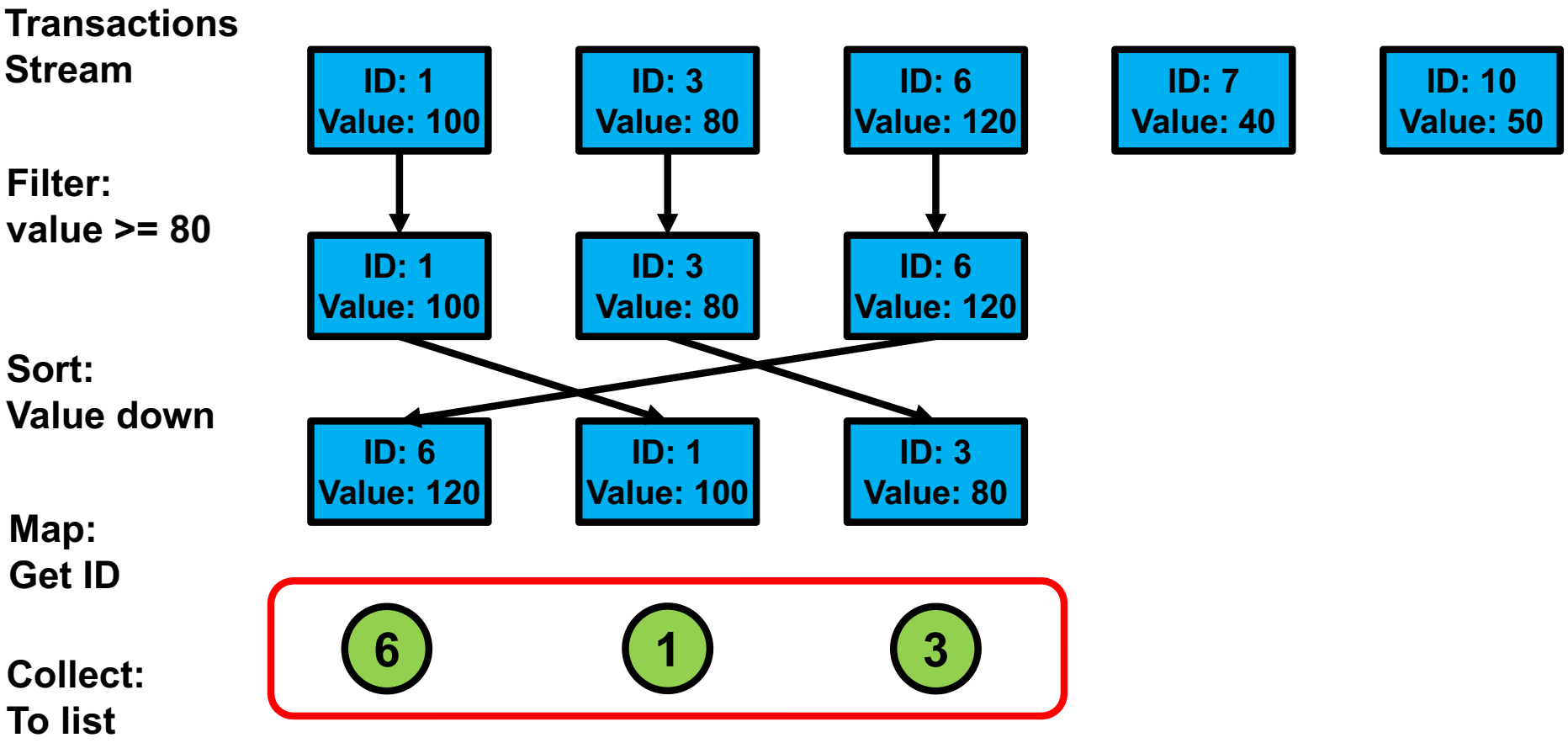
Java 8 Stream

- Given a collection of transactions
  - ID and Value
- Return the list of the IDs of the large transactions (value >= 80), sorted in the decreasing order of value



Java 8 Stream

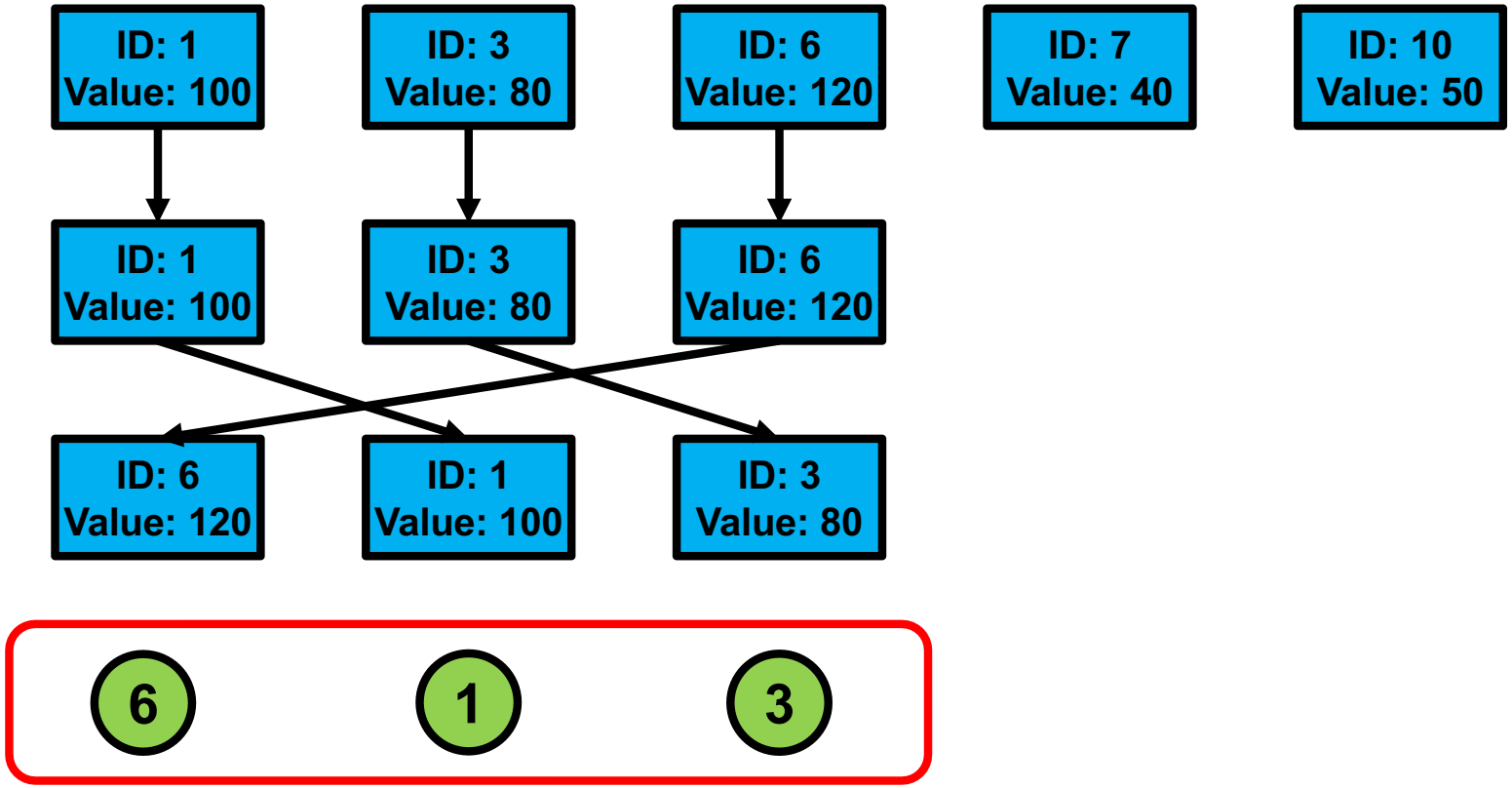
- Not `InputStream/OutputStream`
- Rich library to query and process collections



Java 8 Stream

```
List<Transaction> transactions = …

List<Integer> res = transactions.stream()
    .filter(t -> t.value >= 80)
    .sorted((t1,t2) -> t2.value-t1.value)
    .map(t -> t.id).collect(Collectors.toList());
```



Java 8 Stream

- First, turn collection into a stream
  - `list.stream()`
- Then, lots of operations (lambda arguments)
  - `.filter(Predicate)`
  - `.sorted(Comparator)`
  - `.map(Function)`
  - `.collect(Collector)`
  - `.reduce(BinaryOperator)`
  - `.distinct()`
  - …

What Will Be Printed?

```
List<String> myList =
    Arrays.asList("a1 ", " a2 ", "b1", " c2 ", "c1");

myList = myList.stream()
     .filter(s -> s.startsWith("c"))
     .map(s -> s.trim())
     .collect(Collectors.toList());

for (String s : myList) System.out.println(s);
```

A)
```
"c1"
```

B)
```
" c2 "
"c1"
```

C)
```
"c2"
"c1"
```

What Will Be Printed?

```
List<String> myList =
    Arrays.asList("a1 ", " a2 ", "b1", " c2 ", "c1");

myList = myList.stream()
     .filter(s -> s.startsWith("c"))
     .map(s -> s.trim())
     .collect(Collectors.toList());

for (String s : myList) System.out.println(s);
```

A)

```
"c1"
```

B)

```
" c2 "
"c1"
```

C)

```
"c2"
"c1"
```

What Will Be Printed?

```
List<String> myList =
    Arrays.asList("a1 ", " a2 ", "b1", " c2 ", "c1");

myList = myList.stream()
     .map(s -> s.trim())
     .filter(s -> s.startsWith("c"))
     .collect(Collectors.toList());

for (String s : myList) System.out.println(s);
```

A)

```
"c1"
```

B)

```
" c2 "
"c1"
```

C)

```
"c2"
"c1"
```

What Will Be Printed?

```
List<String> myList =
    Arrays.asList("a1 ", " a2 ", "b1", " c2 ", "c1");

myList = myList.stream()
     .map(s -> s.trim())
     .filter(s -> s.startsWith("c"))
     .collect(Collectors.toList());

for (String s : myList) System.out.println(s);
```

Order makes difference!

A) `"c1"`

B)
```
" c2 "
"c1"
```

C)
```
"c2"
"c1"
```

Create Stream From Value(s)

- `Collection.stream()`
- `Stream.of(T… values)`
- `Stream.of(T value)`

```
List<String> myList = Arrays.asList("a", "b", "c");

Stream<String> s1 = myList.stream();
Stream<String> s2 = Stream.of("a", "b", "c");
Stream<String> s3 = Stream.of("a");
```

Stream Reduce

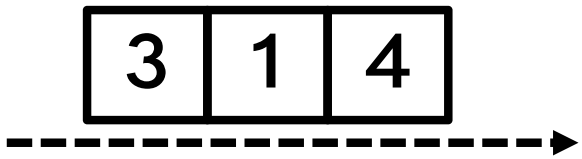
- `T reduce(T identity, BinaryOperator<T> accumulator)`

```
List<Integer> myList = Arrays.asList(3, 1, 4);
int result = 0;
for (Integer element : myList)
 result = result + element;
return result;
```

```
List<Integer> myList = Arrays.asList(3, 1, 4);
int result = myList.stream()
      .reduce(0, (s1,s2) -> s1+s2);
```

Initial value of result

Accumulator for sum



0 +3 +1 +4

Stream in Parallel

- `.parallelStream()`
- Partition into substreams, process in parallel, and combine the results

```
List<String> myList =
    Arrays.asList("a1 ", " a2 ", "b1", " c2 ", "c1");

myList = myList.parallelStream()
    .map(s -> s.trim())
    .filter(s -> s.startsWith("c"))
    .collect(Collectors.toList());
```

Reduce in Parallel

- `<U> U reduce(U identity, BiFunction<U,? super T,U> accumulator, BinaryOperator<U> combiner)`
- `identity:` initial value of the result for each sub-stream
- `accumulator:` accumulator for each sub-stream
- `combiner:` combine the sub-stream results together

- Example: calculate sum age of persons

```
int ageSum = persons.parallelStream()
      .reduce(0,
              (sum, p) -> sum + p.age,
              (sum1, sum2) -> sum1 + sum2);
```

Reduce in Parallel

[(“Marco”, 34); (“Mario”, 20); (“Alice”,9)] 0+34+20+9 = 63

[(“Jack”, 26); (“John”, 10); (“Yoko”,20)] 0+26+10+20 = 56

[(“Steve”, 35); (“Teddy”, 5)] 0+35+5 = 40

63
+
56
+
40
=
159

```
int ageSum = persons.parallelStream()
      .reduce(0,
              (sum, p) -> sum + p.age,
              (sum1, sum2) -> sum1 + sum2);
```

Summary

- Optional
  - Explicitly show which fields are optional
- Stream
  - Rich library to process collections
  - A variety of operations with lambda arguments (functional interfaces)
  - Parallelism