Java Streams Deep Dive

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Dora

Bento

```
public Pug( String name,
            String color,
            Integer weight ) {
     this.name = nome;
     this.color = color;
     this.weight = weight;
 }
```

```
Pug dora = new Pug( "Dora", "abricot", 10 );
Pug bento = new Pug( "Bento", "abricot", 13 );
Pug jesse = new Pug( "Jesse", "black", 9 );
```

Streams API

Streams:

Manipula coleções de forma declarativa

Quais são os nomes dos Pugs com peso maior do que 9 quilos?

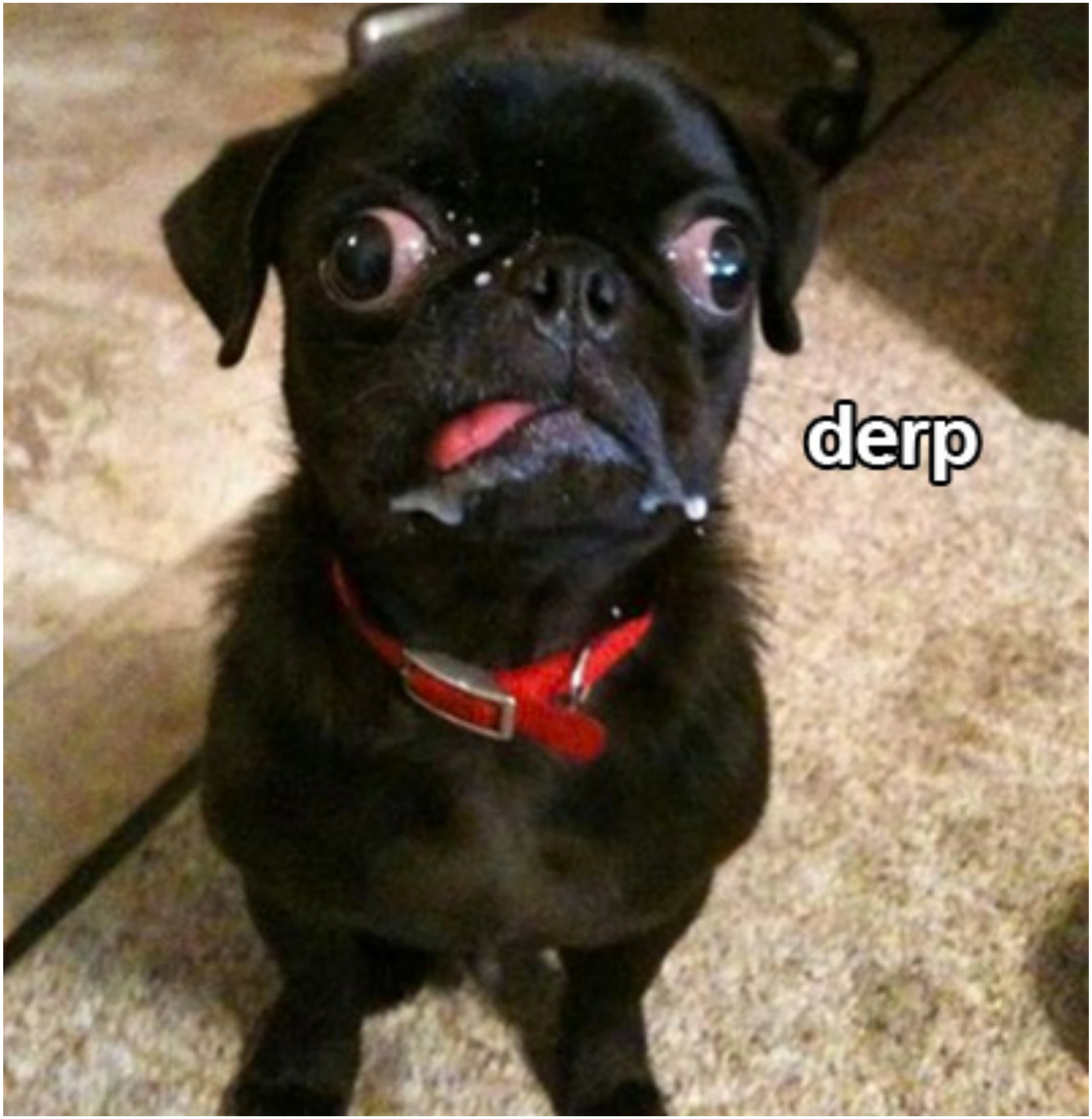
Streams:

Manipula coleções de forma declarativa

```
SELECT nome FROM pugs WHERE weight < 9 order by peso.
```

Em Java

```
List<Pug> gordinhos = new ArrayList<>();
for ( Pug pug : pugs ) {
  if ( pug.getWeight() > 9 ) {
    gordinhos.add( pug );
  }
}
Collections.sort( gordinhos, new Comparator<Pug>() {
          @Override
          public int compare( Pug p1,
                              Pug p2 ) {
              return Integer.compare( p1.getWeight(),
                     p2.getWeight() );
          }
});

List<String> nomeGordinhos = new ArrayList<>();
for ( Pug pug : gordinhos ) {
  nomeGordinhos.add( pug.getNome() );
}
```


derp

Java 8

Streams API

Em Java

```
List<String> fatName =
        pugs.stream()
        .filter( p -> dora.getWeight() > 9 )            Seleciona > 9 kg
        .sorted( comparing( Pug::getWeight ) )          Ordena por peso
        .map( Pug::getNome )                            Extrai o nome
        .collect( toList() );                           Coleta em uma lista
```

Em Java

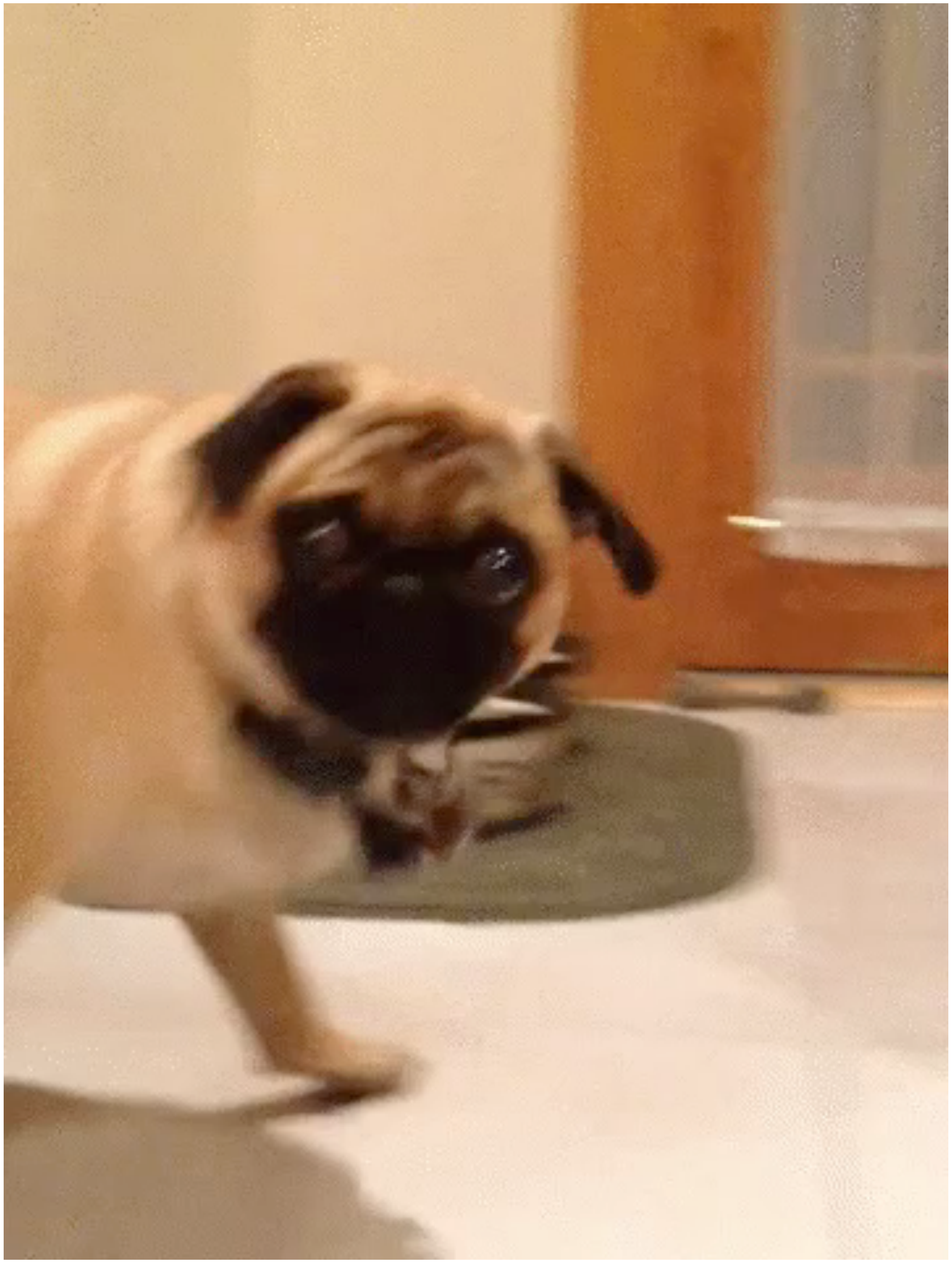
```java
List<String> fatName =
        pugs.parallelStream()
        .filter( p -> dora.getWeight() > 9 )
        .sorted( comparing( Pug::getWeight ) )
        .map( Pug::getNome )
        .collect( toList() );
```

Seleciona > 9 kg

Ordena por peso

Extrai o nome

Coleta em uma lista

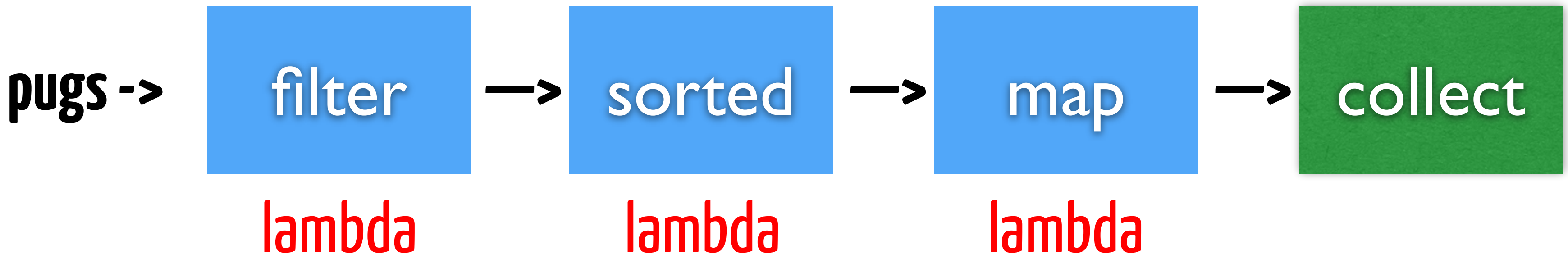


(

Parallel streams não são mágica!

)

Stream Pipelines



Streams API

Código:
Declarativo
Componentizável
Paralelizável

Streams

Sequência de elementos de uma fonte que suporta operações de processamento em seus dados

Streams

Sequência de elementos de uma **fonte** que suporta operações de processamento em seus dados

Streams

Sequência de elementos de uma fonte que suporta **operações de processamento em seus dados**

Streams

Uma fonte de dados para a query
Uma cadeia de operações intermediárias (pipeline)
Uma operação terminal que gera o resultado

Vamos a prática

```
public Venda( Vendedor vendedor,
              int ano,
              int valor ) {
    this.vendedor = vendedor;
    this.ano = ano;
    this.valor = valor;
 }
```

```
public Vendedor( String nome,
                 String cidade ) {
    this.nome = nome;
    this.cidade = cidade;
}
```

```java
Vendedor eder = new Vendedor("Eder", "Campinas");
Vendedor pedro = new Vendedor("Pedro", "Apucarana");
Vendedor luciano = new Vendedor("Luciano", "Piracicaba");
Vendedor junior = new Vendedor("Junior", "Londrina");

List<Venda> transactions = Arrays.asList(
        new Venda( eder, 2015, 100 ),
        new Venda( eder, 2016, 200 ),
        new Venda( pedro, 2015, 300 ),
        new Venda( luciano, 2015, 500 ),
        new Venda( luciano, 2015, 400 ),
        new Venda( junior, 2016, 500 ));
```

Quais são as vendas que fizemos em 2015? Ordenadas?

```
List<Venda> vendas2015 =
        transactions
              .stream()
```

```
List<Venda> vendas2015 =
         transactions
                .stream()
                .filter( venda -> venda.getAno() == 2015 )
```

```
List<Venda> vendas2015 =
         transactions
                 .stream()
                 .filter( venda -> venda.getAno() == 2015 )
                 .sorted( comparing( Venda::getValor ) )
```

```java
List<Venda> vendas2015 =
         transactions
                .stream()
                .filter( venda -> venda.getAno() == 2015 )
                .sorted( comparing( Venda::getValor ) )
                .collect( toList() );
```

```java
List<Venda> vendas2015 =
         transactions
                 .stream()
                 .filter( venda -> venda.getAno() == 2015 )
                 .sorted( comparing( Venda::getValor ) )
                 .collect( toList() );
```

```java
vendas2015.forEach(System.out::println);
```

```
Venda{vendedor=Vendedor{nome='Eder', cidade='Campinas'}, ano=2015, valor=100}
Venda{vendedor=Vendedor{nome='Pedro', cidade='Apucarana'}, ano=2015, valor=300}
Venda{vendedor=Vendedor{nome='Luciano', cidade='Piracicaba'}, ano=2015, valor=400}
Venda{vendedor=Vendedor{nome='Luciano', cidade='Piracicaba'}, ano=2015, valor=500}
```

Em que cidades temos vendedores?

```
List<String> cidadesAtendidas =
        vendas.stream()
                .map( venda ->venda.getVendedor().getCidade() )
                .distinct()
                .collect( toList() );
```

```
Campinas
Apucarana
Piracicaba
Londrina
```

Qual foi a maior venda?

```
      OptionalInt maiorVenda =
              vendas.stream()
                            .mapToInt(Venda::getValor)
                            .reduce( Integer::max );

maiorVenda.ifPresent( i -> System.out.println(i));
```

```
500
```

Total de vendas?

```java
OptionalInt total =
        vendas.stream()
                .mapToInt(Venda::getValor)
                .reduce( Integer::sum );

total.ifPresent( i -> System.out.println(i));
```

```
2000
```

Quais são as vendas de cada vendedor? Ordenadas?

```
Map<Vendedor, List<Venda>> vendedorPorVendas =

        vendas.stream()
        .sorted( comparing( Venda::getValor ) )
        .collect( groupingBy( Venda::getVendedor ) );
```

```java
Map<Vendedor, List<Venda>> vendedorPorVendas =

        vendas.stream()
        .sorted( comparing( Venda::getValor ) )
        .collect( groupingBy( Venda::getVendedor ) );
```

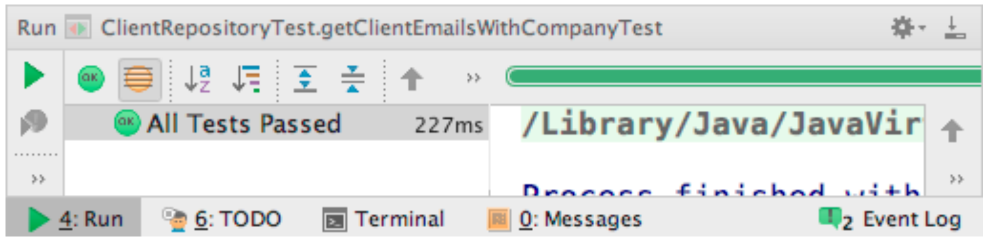
```
{Vendedor{nome='Junior', cidade='Londrina'}=[Venda{vendedor=Vendedor{nome='Junior',
cidade='Londrina'}, ano=2016, valor=500}],

Vendedor{nome='Eder', cidade='Campinas'}=[Venda{vendedor=Vendedor{nome='Eder',
cidade='Campinas'}, ano=2015, valor=100}, Venda{vendedor=Vendedor{nome='Eder',
cidade='Campinas'}, ano=2016, valor=200}],

Vendedor{nome='Pedro', cidade='Apucarana'}=[Venda{vendedor=Vendedor{nome='Pedro',
cidade='Apucarana'}, ano=2015, valor=300}],

 Vendedor{nome='Luciano', cidade='Piracicaba'}
=[Venda{vendedor=Vendedor{nome='Luciano', cidade='Piracicaba'}, ano=2015,
valor=400}, Venda{vendedor=Vendedor{nome='Luciano', cidade='Piracicaba'}, ano=2015,
valor=500}]}
```

Refactoring Loops to Collection Pipelines

```java
public class Client {

    private String name;
    private String email;
    private Company company;

    public Client( String name, String email, Company company ) {
        this.name = name;
        this.email = email;
        this.company = company;
    }

    public Client( String name ) {
        this.name = name;
    }

    public Client( String name, String email ) {
        this.name = name;
        this.email = email;
    }

 …
}
```

```java
public class ClientRepositoryTest {


    private ClientRepository repo;

    @Before
    public void setup() {
        Company empresa = new Company( "RedHat" );
        Client completo1 = new Client( "Completo1", "completo1@redhat.com", empresa );
        Client completo2 = new Client( "Completo2", "completo2@redhat.com", empresa );
        Client semEmpresa = new Client( "SemEmpresa", "semEmpresa@ederign.me" );
        Client somenteNome = new Client( "SomenteNome" );
        repo = new ClientRepository(
                     Arrays.asList( completo1, semEmpresa, completo2, somenteNome ) );

    }

    @Test
    public void getClientEmailsWithCompanyTest() {
        List<String> clientMails = repo.getClientMails();
        assertEquals( 2, clientMails.size() );
        assertTrue( clientMails.contains( "completo1@redhat.com" ) );
        assertTrue( clientMails.contains( "completo2@redhat.com" ) );
        assertTrue( !clientMails.contains( "semEmpresa@ederign.me" ) );
    }
}
```

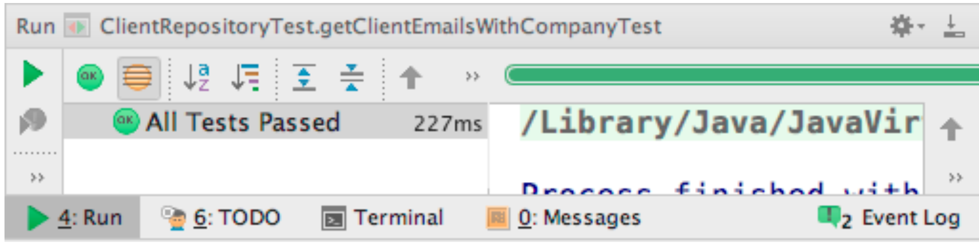
```
public List<String> getClientMails() {
    ArrayList<String> emails = new ArrayList<>();

    for ( Client client : clients ) {
        if ( client.getCompany() != null ) {
            String email = client.getEmail();
            if ( email != null ){
                emails.add( email );
            }
        }
    }

    return emails;
}
```



```
ClientRepositoryTest.getClientEmailsWithCompanyTest
All Tests Passed   227ms
/Library/Java/JavaVir
Process finished with
```

```
    public List<String> getClientMails() {
        ArrayList<String> emails = new ArrayList<>();
        List<Client> pipeline = clients;
        for ( Client client : pipeline ) {
            if ( client.getCompany() != null ) {
                String email = client.getEmail();
                if ( email != null ){
                    emails.add( email );
                }
            }
        }
        return emails;
    }
}
```

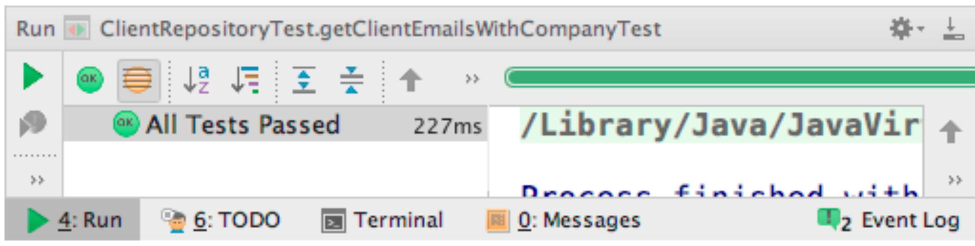
Extract Variable



```
Run  ClientRepositoryTest.getClientEmailsWithCompanyTest
All Tests Passed    227ms    /Library/Java/JavaVir
```

```
    public List<String> getClientMails() {
        ArrayList<String> emails = new ArrayList<>();
        List<Client> pipeline = clients
                .stream()
                .filter( c -> c.getCompany() != null )
                .collect( Collectors.toList() );
        for ( Client client : pipeline ) {
            if ( client.getCompany() != null ) {
                String email = client.getEmail();
                if ( email != null ) {
                    emails.add( email );
                }
            }
        }

        return emails;
    }
}
```

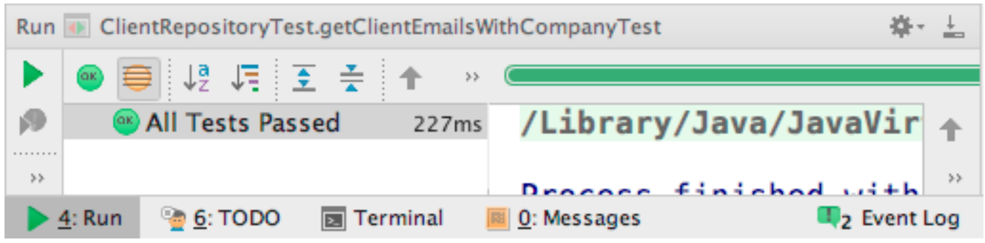
Filter Operation



```
ClientRepositoryTest.getClientEmailsWithCompanyTest
All Tests Passed    227ms
/Library/Java/JavaVir
Process finished with
```

```
public List<String> getClientMails() {
     ArrayList<String> emails = new ArrayList<>();
     List<String> pipeline = clients
             .stream()
             .filter( c -> c.getCompany() != null )
             .map( c -> c.getEmail() )
             .collect( Collectors.toList() );
     for ( String mail : pipeline ) {
         String email = client.getEmail();
         if ( mail != null ) {
             emails.add( mail );
         }
     }

     return emails;
 }
```

Map Operation



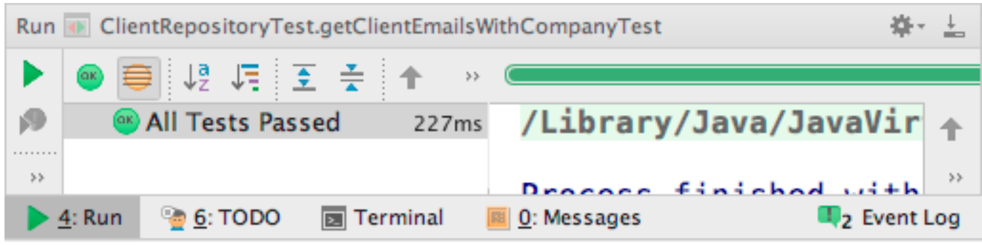
ClientRepositoryTest.getClientEmailsWithCompanyTest

All Tests Passed 227ms

```
/Library/Java/JavaVir

Process finished with
```

```
public List<String> getClientMails() {
    ArrayList<String> emails = new ArrayList<>();
    List<String> pipeline = clients
            .stream()
            .filter( c -> c.getCompany() != null )
            .map( c -> c.getEmail() )
            .filter( m -> m != null )
            .collect( Collectors.toList() );
    for ( String mail : pipeline ) {
        if ( mail != null ) {
            emails.add( mail );
        }
    }

    return emails;
}
```

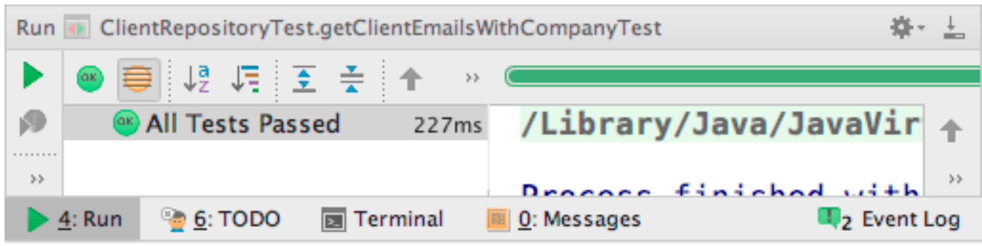
Filter Operation



```
ClientRepositoryTest.getClientEmailsWithCompanyTest
All Tests Passed    227ms
/Library/Java/JavaVir
Process finished with
```

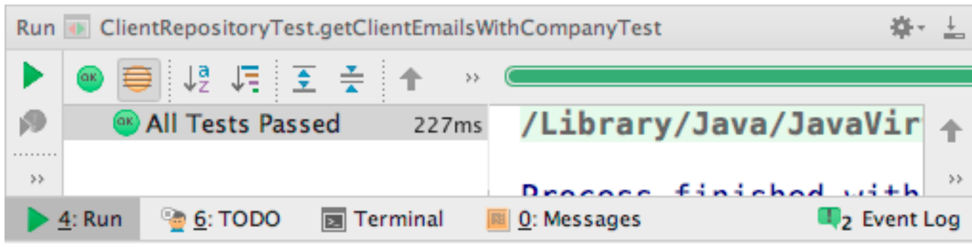
```
public List<String> getClientMails() {
    ArrayList<String> emails = new ArrayList<>();
    return clients
            .stream()
            .filter( c -> c.getCompany() != null )
            .map( c -> c.getEmail() )
            .filter( m -> m != null )
            .collect( Collectors.toList() );
    for ( String mail : pipeline ) {
        if ( mail != null ) {
            emails.add( mail );
        }
    }

    return emails;
}
```

Pipeline



```
Run  ClientRepositoryTest.getClientEmailsWithCompanyTest
All Tests Passed   227ms
/Library/Java/JavaVir
Process finished with
```

```java
public List<String> getClientMails() {
    return clients
            .stream()
            .filter( c -> c.getCompany() != null )
            .map( c -> c.getEmail() )
            .filter( m -> m != null )
            .collect( Collectors.toList() );
}
```



ClientRepositoryTest.getClientEmailsWithCompanyTest

All Tests Passed 227ms

```
/Library/Java/JavaVir

Process finished with
```

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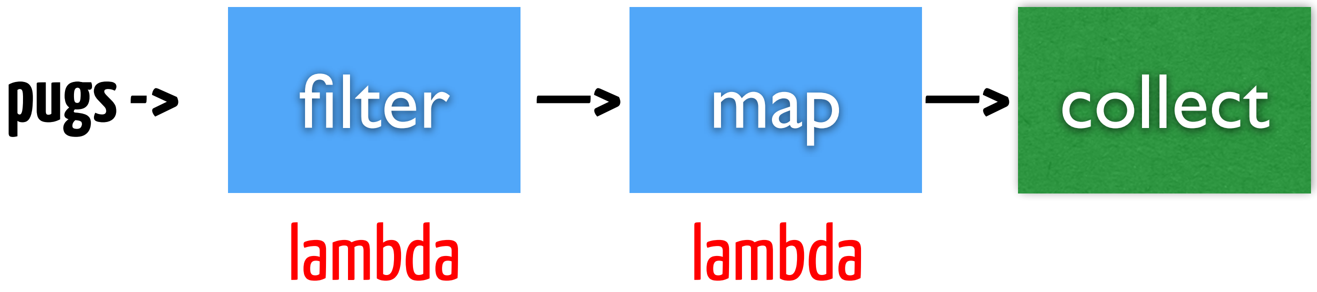
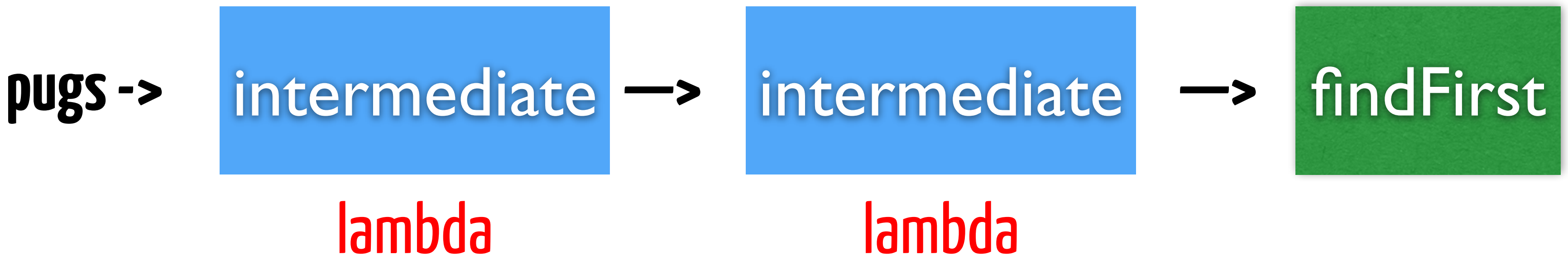
Functional programming for the MEOW!

Streams são lazy

Stream Pipelines



Stream Pipelines



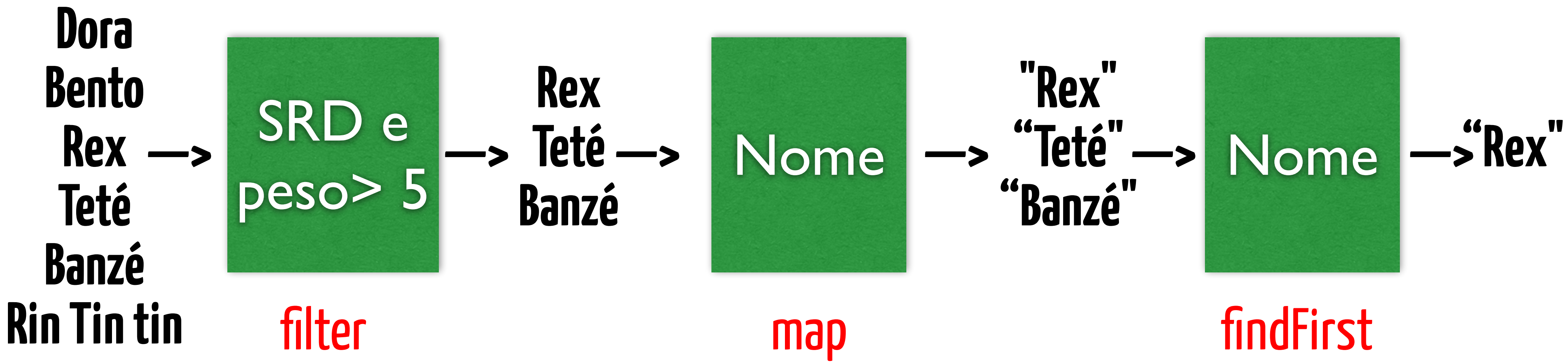
Lazy Streams

```
List<Dog> dogs = Arrays.asList(
          new Dog( "Dora", 10, Dog.BREED.PUG ),
          new Dog( "Bento", 13, Dog.BREED.PUG ),
          new Dog( "Rex", 8, Dog.BREED.SRD ),
          new Dog( "Tetezinha", 6, Dog.BREED.SRD ),
          new Dog( "Banze", 7, Dog.BREED.SRD ),
          new Dog( "Rufus", 15, Dog.BREED.BULLDOG ) );
```

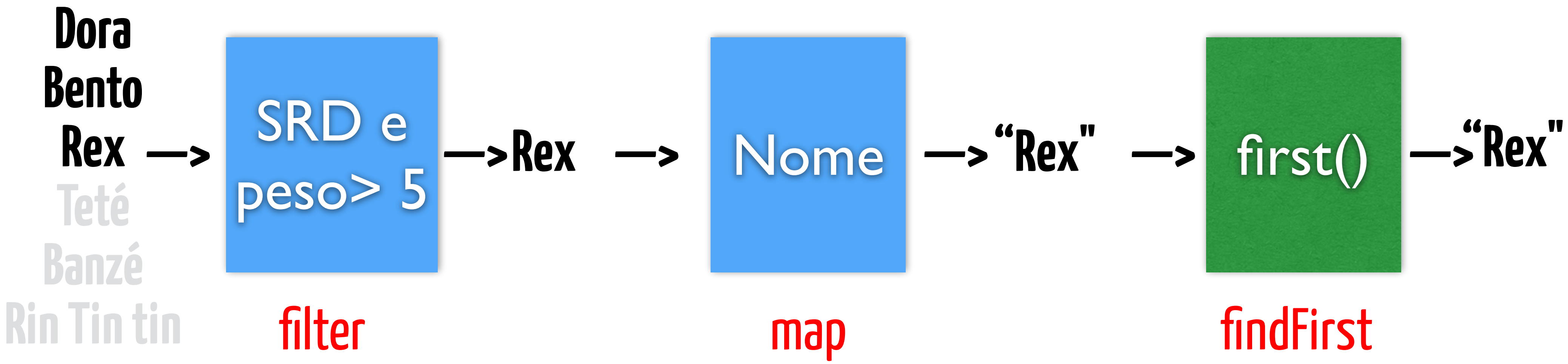
Qual o nome do primeiro SRD
que pesa mais do que 5kg?

```
String nomePrimeiroSRDMaiorDoQue5Kg =
        dogs.stream()

                .filter( dog -> {
                    return dog.getBreed().equals( Dog.BREED.SRD )
                            && dog.getWeight() > 5;
                } )

                .map( dog -> {
                    return dog.getName();
                } )

                .findFirst()

                .get();
```

Eager Streams



Lazy Stream


Dora
Bento
Rex
Teté
Banzé
Rin Tin tin
—>
SRD e peso> 5
filter
—>Rex
—>
Nome
map
—> "Rex"
—>
first()
findFirst
—>"Rex"

```java
List<Dog> dogs = Arrays.asList(
          new Dog( "Dora", 10, Dog.BREED.PUG ),
          new Dog( "Bento", 13, Dog.BREED.PUG ),
          new Dog( "Rex", 8, Dog.BREED.SRD ),
          new Dog( "Tetezinha", 6, Dog.BREED.SRD ),
          new Dog( "Banze", 7, Dog.BREED.SRD ),
          new Dog( "Rufus", 15, Dog.BREED.BULLDOG ) );
```

```java
String nomePrimeiroSRDMaiorDoQue5Kg =
        dogs.stream()

                .filter( dog -> {
                    return dog.getBreed().equals( Dog.BREED.SRD )
                            && dog.getWeight() > 5;
                } )

                .map( dog -> {
                    return dog.getName();
                } )

                .findFirst()

                .get();
```

filter - Dora
filter - Bento
filter - Rex
map - Rex
Rex

Streams "infinitos"

Criar uma lista de números primos infinita

```java
public static boolean isPrime( final int number ) {
    return number > 1 &&
            IntStream.rangeClosed( 2, ( int ) Math.sqrt( number ) )
                    .noneMatch( divisor -> number % divisor == 0 );
}


public static int primeAfter( final int number ) {
    if ( isPrime( number + 1 ) ) {
        return number + 1;
    } else {
        return primeAfter( number + 1 );
    }
}
```

```java
public static IntStream primesInfinityStream( int fromNumber) {
        return IntStream.iterate( primeAfter( fromNumber - 1 ),
                                  Primes::primeAfter );
}
```

```java
primesInfinityStream( 1 )
        .limit( 10 )
        .forEach( i -> System.out.print( i+ ", " ) );

primesInfinityStream( 1000 )
        .limit( 5 )
        .forEach( i -> System.out.print( i+ ", " ) );
```

```
2, 3, 5, 7, 11, 13, 17, 19, 23, 29,

1009, 1013, 1019, 1021, 1031
```

FlatMap

```java
Developer eder = new Developer();
eder.bestBooks( "Java 8 in Action", "SICP", "The Little Schemer" );

Developer dora = new Developer();
dora.bestBooks( "Effective Java", "Pragmatic Programmer", "SICP" );


List<Developer> devs = Arrays.asList( eder, dora );

List<String> booksNames = devs
         .stream()
         .map( dev -> dev.getBooks() )  //Stream<Set<String>>
         .flatMap( books -> books.stream() )//Stream<String>
         .distinct()
         .collect( Collectors.toList() );

booksNames.forEach( System.out::println );
```

IntStream

DoubleStream, LongStream...

```
IntStream.of( 1, 2, 3);
        // > 1, 2, 3
IntStream.range(1, 3);
        // > 1, 2
```

```java
dogs.stream() //Stream<Dog>
   .filter( dog -> dog.getBreed().equals( Dog.BREED.PUG ) )//Stream<Dog>
   .map( Dog::getWeight )//Stream<Integer> boxing :(
   .filter( weight -> weight > 10 )//Stream<Integer> boxing reboxing
   .mapToInt( weight -> weight ) //IntStream
   .sum();
```

0.185s

```
dogs.stream()//Stream<Dog>
   .filter( dog -> dog.getBreed().equals( Dog.BREED.PUG ) )//Stream<Dog>
   .mapToInt( Dog::getWeight ) //IntStream
   .filter( weight -> weight > 10 ) //IntStream
   .sum();
```

0.004s

```java
dogs.stream()//Stream<Dog>
   .filter( dog -> dog.getBreed().equals( Dog.BREED.PUG ) )//Stream<Dog>
   .mapToInt( Dog::getWeight ) //IntStream
   .filter( weight -> weight > 10 ) //IntStream
   .max();
```

0.004s

```
dogs.stream()//Stream<Dog>
   .filter( dog -> dog.getBreed().equals( Dog.BREED.PUG ) )//Stream<Dog>
   .mapToInt( Dog::getWeight ) //IntStream
   .filter( weight -> weight > 10 ) //IntStream
   .summaryStatistics();
```

```
IntSummaryStatistics{count=224, sum=4490, min=11,
average=20.044643, max=30}
```

ParallelStreams

```java
dogs.stream()//Stream<Dog>
   .mapToInt( Dog::getWeight ) //IntStream
   .filter( weight -> weight > 10 ) //IntStream
   .sum();
```

0.129s

```
dogs.parallelStream()//Stream<Dog>
   .mapToInt( Dog::getWeight ) //IntStream
   .filter( weight -> weight > 10 ) //IntStream
   .sum();
```

0.017s

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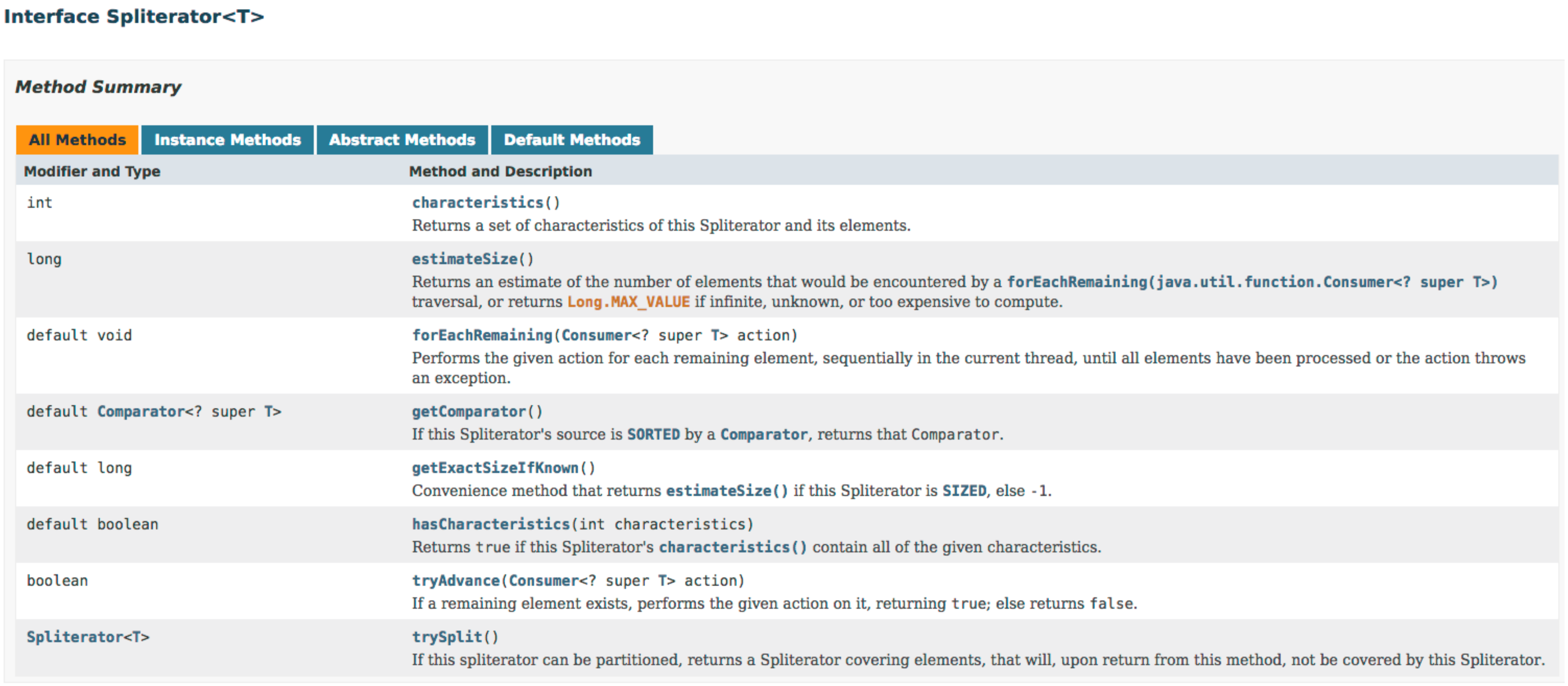
Multithreaded programming

```
dogs.parallelStream()
   .mapToInt( Dog::getWeight )
   .reduce( Math::max )
   .ifPresent( p -> System.out.println( "Maior peso: " + p ) );
```

java.util.Spliterator
java.util.concurrent.ForkJoinPool.commonPool()

java.util.Spliterator

Spliterator = splitter + iterator



Interface Spliterator<T>

Method Summary

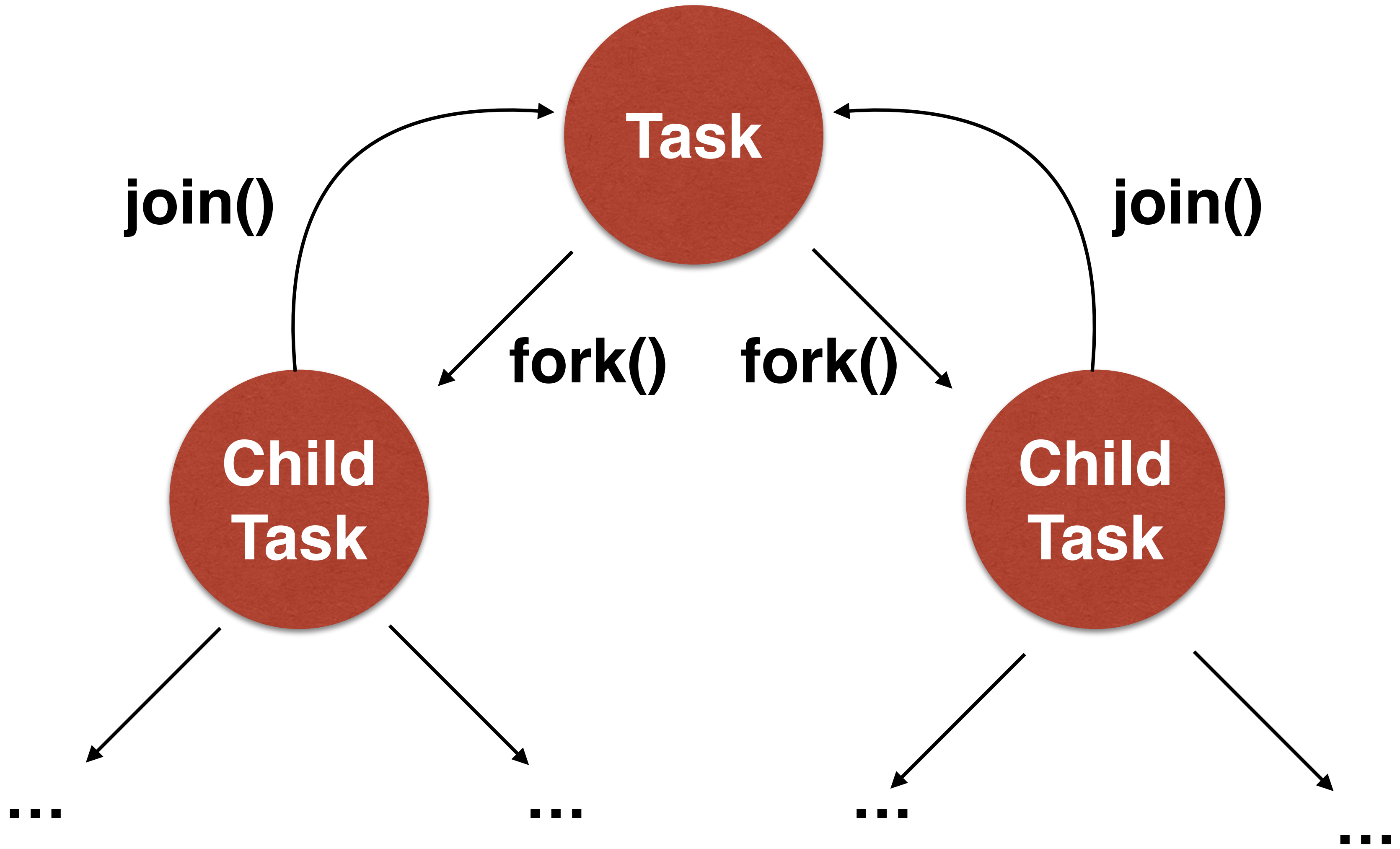
All Methods | Instance Methods | Abstract Methods | Default Methods

Modifier and Type	Method and Description
`int`	`characteristics()` Returns a set of characteristics of this Spliterator and its elements.
`long`	`estimateSize()` Returns an estimate of the number of elements that would be encountered by a `forEachRemaining(java.util.function.Consumer<? super T>)` traversal, or returns `Long.MAX_VALUE` if infinite, unknown, or too expensive to compute.
`default void`	`forEachRemaining(Consumer<? super T> action)` Performs the given action for each remaining element, sequentially in the current thread, until all elements have been processed or the action throws an exception.
`default Comparator<? super T>`	`getComparator()` If this Spliterator's source is `SORTED` by a `Comparator`, returns that `Comparator`.
`default long`	`getExactSizeIfKnown()` Convenience method that returns `estimateSize()` if this Spliterator is `SIZED`, else `-1`.
`default boolean`	`hasCharacteristics(int characteristics)` Returns `true` if this Spliterator's `characteristics()` contain all of the given characteristics.
`boolean`	`tryAdvance(Consumer<? super T> action)` If a remaining element exists, performs the given action on it, returning `true`; else returns `false`.
`Spliterator<T>`	`trySplit()` If this spliterator can be partitioned, returns a Spliterator covering elements, that will, upon return from this method, not be covered by this Spliterator.

	seq	paralel
ArrayList	8.33 ms	6.33 ms
LinkedList	12.74 ms	19.57 ms
HashSet	20.76 ms	16.01 ms
TreeSet	19.79 ms	15.49 ms

java.util.concurrent.ForkJoinPool.commonPool()

Fork Join Framework


Task
join()
join()
fork()
fork()
Child Task
Child Task
...
...
...
...

CommonPool

Singleton fork-join pool instance

```java
public static String query( String question ) {
     List<String> engines = new ArrayList<>();
     engines.add( "https://www.google.com/?q=" );
     engines.add( "https://duckduckgo.com/?q=" );
     engines.add( "https://www.bing.com/search?q=" );

     // get element as soon as it is available
     Optional<String> result = engines.stream()
                                         .parallel().map( ( base ) -> {
         String url = base + question;
         // open connection and fetch the result
         return Util.read( url );
     } ).findAny();
     return result.get();
 }
```

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```

```
dogs.parallelStream()
   .mapToInt( Dog::getWeight )
   .reduce( Math::max )
   .ifPresent( p -> System.out.println( "Maior peso: " + p ) );
```

I HAD A
BAD
DAY

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```
public List<String> getClientMails() {
    return clients
            .stream()
            .filter( c -> c.getCompany() != null )
            .map( c -> c.getEmail() )
            .filter( m -> m != null )
            .collect( Collectors.toList() );
}
```

Happy Pug
is happy
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Obrigado!!!

@ederign

redhat