
50
new things we can do with
Java
8
@JosePaumard


0x50
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Questions?

#50new8

Date

Date: Instant

An Instant is a point on the time line

```
Instant start = Instant.now() ;

Instant end = Instant.now() ;
```

Date: Duration

A « duration » is the amount of time between instants

```
Instant start = Instant.now() ;

Instant end = Instant.now() ;
```

```
Duration elapsed = Duration.between(start, end) ;
long millis = elapsed.toMillis() ;
```

Date: Duration

There is an arithmetic on durations

```
Instant start = Instant.now() ;

Instant end = Instant.now() ;
```

```
Duration elapsed = Duration.between(start, end) ;
long millis = elapsed.toMillis() ;
```

```
elapsed.plus(2L, ChronoUnit.SECONDS) ;
```

Date: Duration

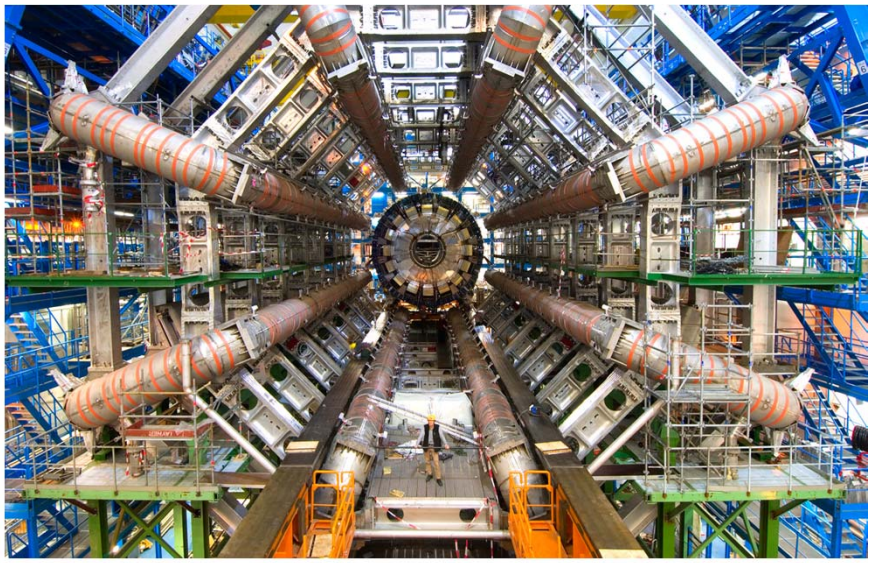
The precision of the time line is 10^{-9} s (nanosecond)

Date: Duration

The precision of the time line is 10^{-9} s (nanosecond)
You think it's high precision?

Date: Duration

The precision of the time line is 10^{-9} s (nanosecond)
You think it's high precision?



Well the λ of the
Higgs boson is 10^{-23} s

Date: LocalDate

A LocalDate is an « every day » date

```
LocalDate now = LocalDate.now() ;

LocalDate shakespeareDoB =
   LocaleDate.of(1564, Month.APRIL, 23) ;
```

Date: Period

A « period » is the amount of time between local dates

```
LocalDate now = LocalDate.now() ;

LocalDate shakespeareDoB =
   LocaleDate.of(1564, Month.APRIL, 23) ;

Period p = shakespeareDoB.until(now) ;
System.out.println("# years = " + p.getYears()) ;
```

Date: Period

A « period » is the amount of time between local dates

```
LocalDate now = LocalDate.now() ;

LocalDate shakespeareDoB =
   LocaleDate.of(1564, Month.APRIL, 23) ;

Period p = shakespeareDoB.until(now) ;
System.out.println("# years = " + p.getYears()) ;
```

```
long days = shakespeareDoB.until(now, ChronoUnit.DAYS) ;
System.out.println("# days = " + days) ;
```

Date: TemporalAdjuster

Arithmetic with local dates

```
LocalDate now = LocalDate.now() ;

LocalDate nextSunday =
   now.with(TemporalAdjusters.next(DayOfWeek.SUNDAY)) ;
```

Date: TemporalAdjuster

Arithmetic with local dates

```
LocalDate now = LocalDate.now() ;

LocalDate nextSunday =
   now.with(TemporalAdjusters.next(DayOfWeek.SUNDAY)) ;
```

A toolbox of 14 static methods
firstDayOfMonth(), lastDayOfYear()
firstDayOfNextMonth()

Date: TemporalAdjuster

Arithmetic with local dates

```
LocalDate now = LocalDate.now() ;

LocalDate nextSunday =
   now.with(TemporalAdjusters.next(DayOfWeek.SUNDAY)) ;
```

A toolbox of 14 static methods
firstInMonth(DayOfWeek.MONDAY)
next(DayOfWeek.FRIDAY)

Date: LocalTime

A LocalTime is an everyday time: ex. 10:20

```
LocalTime now = LocalTime.now() ;

LocalTime time = LocalTime.of(10, 20) ; // 10:20
```

Date: LocalTime

A LocalTime is an everyday time: ex. 10:20

```
LocalTime now = LocalTime.now() ;

LocalTime time = LocalTime.of(10, 20) ; // 10:20
```

```
LocalTime lunchTime = LocalTime.of(12, 30) ;

LocalTime coffeeTime = lunchTime.plusHours(2) ; // 14:20
```

Date: ZonedTime

Useful for localized times

```
Set<String> allZonesIds = ZoneId.getAvailableZoneIds() ;

String ukTZ = ZoneId.of("Europe/London") ;
```

Date: ZonedTime

Useful for localized times

```
System.out.println(
   ZonedDateTime.of(
      1564, Month.APRIL.getValue(), 23, // year / month / day
      10, 0, 0, 0,                      // h / mn / s / nanos
      ZoneId.of("Europe/London"))
); // prints 1564-04-23T10:00-00:01:15[Europe/London]
```

Date: ZonedTime

Arithmetic on localized time

```
ZonedDateTime currentMeeting =
   ZonedDateTime.of(
      LocalDate.of(2014, Month.APRIL, 18), // LocalDate
      LocalTime.of(9, 30),                 // LocalTime
      ZoneId.of("Europe/London")
);

ZonedDateTime nextMeeting =
   currentMeeting.plus(Period.ofMonth(1));
```

Date: ZonedTime

Arithmetic on localized time

```
ZonedDateTime currentMeeting =
   ZonedDateTime.of(
      LocalDate.of(2014, Month.APRIL, 18), // LocalDate
      LocalTime.of(9, 30),                 // LocalTime
      ZoneId.of("Europe/London")
);

ZonedDateTime nextMeeting =
   currentMeeting.plus(Period.ofMonth(1)) ;
ZonedDateTime nextMeetingUS =
   nextMeeting.withZoneSameInstant(ZoneId.of("US/Central")) ;
```

Date: Formatter

Factory class: DateTimeFormatter

```
ZonedDateTime nextMeetingUS =
   nextMeeting.withZoneSameInstant(ZoneId.of("US/Central"));

System.out.println(
   DateTimeFormatter.ISO_DATE_TIME.format(nextMeetingUS)
);
// prints 2014-04-12T03:30:00-05:00[US/Central]

System.out.println(
   DateTimeFormatter.RFC_1123_DATE_TIME.format(nextMeetingUS)
);
// prints Sat, 12 Apr 2014 03:30:00 -0500
```

Date: bridges with java.util.Date

```
Date date = Date.from(instant);              // API -> legacy
Instant instant = date.toInstant();          // legacy -> new API
```

Date: bridges with java.util.Date

```
Date date = Date.from(instant);             // API -> legacy
Instant instant = date.toInstant();         // legacy -> new API
```

```
TimeStamp time = TimeStamp.from(instant); // API -> legacy
Instant instant = time.toInstant();       // legacy -> new API
```

Date: bridges with java.util.Date

```
Date date = Date.from(instant);             // API -> legacy
Instant instant = date.toInstant();         // legacy -> new API
```

```
TimeStamp time = TimeStamp.from(instant); // API -> legacy
Instant instant = time.toInstant();       // legacy -> new API
```

```
Date date = Date.from(localDate);           // API -> legacy
LocalDate localDate = date.toLocalDate(); // legacy -> new API
```

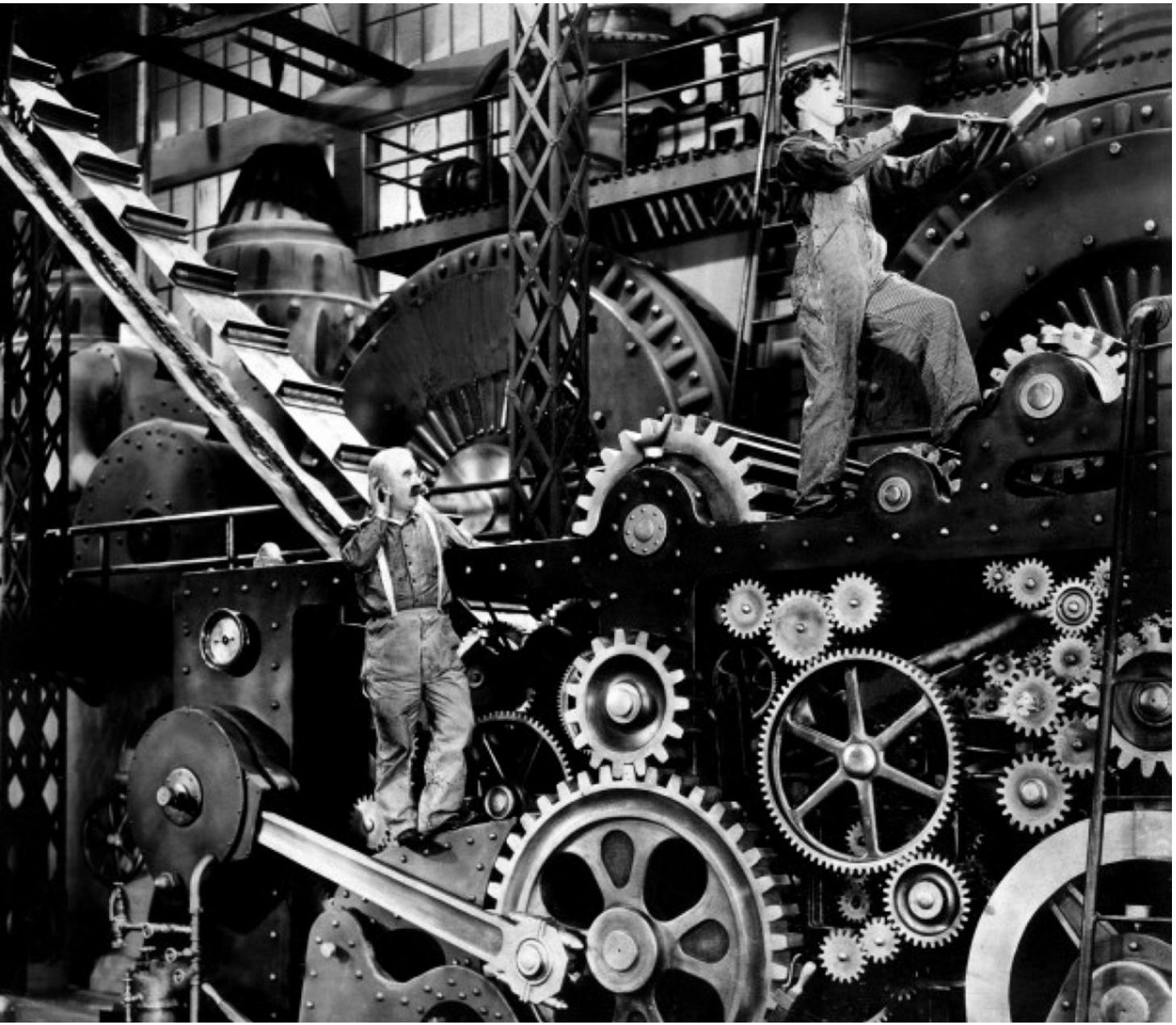
Date: bridges with java.util.Date

```
Date date = Date.from(instant);             // API -> legacy
Instant instant = date.toInstant();         // legacy -> new API
```

```
TimeStamp time = TimeStamp.from(instant); // API -> legacy
Instant instant = time.toInstant();       // legacy -> new API
```

```
Date date = Date.from(localDate);           // API -> legacy
LocalDate localDate = date.toLocalDate(); // legacy -> new API
```

```
Time time = Time.from(localTime);           // API -> legacy
LocalTime localTime = time.toLocalTime(); // legacy -> new API
```



String

Building a Stream on a String

Building a Stream on the letters of a String:

```
String s = "hello";
IntStream stream = s.chars(); // stream on the letters of s
```

Building a Stream on a String

Building a Stream on the letters of a String:

```
String s = "hello";
IntStream stream = s.chars(); // stream on the letters of s

s.chars()
 .map(Character::toUpperCase)
 .forEach(System.out::println);
```

Building a Stream on a String

Building a Stream on the letters of a String:

```
String s = "hello";
IntStream stream = s.chars(); // stream on the letters of s

s.chars()
 .map(Character::toUpperCase)
 .forEach(System.out::println);
```

```
> 72
  69
  76
  76
  79
```

Building a Stream on a String

Building a Stream on the letters of a String:

```
String s = "hello";
IntStream stream = s.chars(); // stream on the letters of s

s.chars()                                // IntStream
 .map(Character::toUpperCase)
 .forEach(System.out::println);          // Prints an int!
```

```
> 7269767679
```

Building a Stream on a String

Building a Stream on the letters of a String:

```
String s = "hello";
IntStream stream = s.chars(); // stream on the letters of s

s.chars()                                // IntStream
 .mapToObj(letter -> (char)letter) // Stream<Character>
 .map(Character::toUpperCase)
 .forEach(System.out::println);    // Prints a Character
```

```
> HELLO
```

String: regular expressions

Building a Stream from a regexp

```
// book is a looooooooong String
Stream<String> words =
   Pattern
      .compile("[^\\p{javaLetter}]")
      .splitAsStream(book) ;
```

String: concatenation

The newbie writes:

```
String s1 = "hello" ;
String s2 = " world!" ;

String s3 = s1 + " " + s2 ;
```

String: concatenation

The ignorant tells him to write:

```
StringBuffer sb1 = new StringBuffer("hello") ;
sb1.append(" world") ;

String s3 = sb1.toString() ;
```

(and is wrong)

String: concatenation

The seasonned dev tells him to write:

```
StringBuilder sb1 = new StringBuilder("hello") ;
sb1.append(" world") ;

String s3 = sb1.toString() ;
```

(and is wrong too…)

String: concatenation

Because the newbie is right (even if he doesn't know)

```
String s1 = "hello" ;
String s2 = " world!" ;
```

```
LINENUMBER 10 L2
   NEW java/lang/StringBuilder
   DUP
   ALOAD 1
   INVOKESTATIC java/lang/String.valueOf(Ljava/lang/Object;)Ljava/lang/String;
   INVOKESPECIAL java/lang/StringBuilder.<init>(Ljava/lang/String;)V
   LDC " "
   INVOKEVIRTUAL java/lang/StringBuilder.append(Ljava/lang/String;)Ljava/lang/StringBuilder;
   ALOAD 2
   INVOKEVIRTUAL java/lang/StringBuilder.append(Ljava/lang/String;)Ljava/lang/StringBuilder;
   INVOKEVIRTUAL java/lang/StringBuilder.toString()Ljava/lang/String;
   ASTORE 3
```

String: concatenation

The Java 8 well-trained dev writes:

```
// The JDK 8 way
StringJoiner sj = new StringJoiner(", ") ;
sj.add("one").add("two").add("three") ;
String s = sj.toString() ;
System.out.println(s) ;
```

String: concatenation

The Java 8 well-trained dev writes:

```
// The JDK 8 way
StringJoiner sj = new StringJoiner(", ") ;
sj.add("one").add("two").add("three") ;
String s = sj.toString() ;
System.out.println(s) ;
```

And it prints:

```
> one, two, three
```

String: concatenation

The Java 8 well-trained dev writes:

```
// The JDK 8 way
StringJoiner sj = new StringJoiner(", ") ;
sj.add("one") ;
String s = sj.toString() ;
System.out.println(s) ;
```

And it prints:

```
> one
```

String: concatenation

The Java 8 well-trained dev writes:

```
// The JDK 8 way
StringJoiner sj = new StringJoiner(", ", "{", "}") ;
sj.add("one").add("two").add("three") ;
String s = sj.toString() ;
System.out.println(s) ;
```

And it prints:

```
> {one, two, three}
```

String: concatenation

The Java 8 well-trained dev writes:

```
// The JDK 8 way
StringJoiner sj = new StringJoiner(", ", "{", "}") ;
sj.add("one") ;
String s = sj.toString() ;
System.out.println(s) ;
```

And it prints:

```
> {one}
```

String: concatenation

The Java 8 well-trained dev writes:

```
// The JDK 8 way
StringJoiner sj = new StringJoiner(", ", "{", "}") ;
// we dont put anything in it
String s = sj.toString() ;
System.out.println(s) ;
```

And it prints:

```
> {}
```

String: concatenation

And it's nearly accessible from the String class itself:

```
// From the String class, with a vararg
String s = String.join(", ", "one", "two", "three");
System.out.println(s);
```

And it prints:

```
> one, two, three
```

String: concatenation

And it's nearly accessible from the String class itself:

```
// From the String class, with an Iterable
String [] tab = {"one", "two", "three"} ;
String s = String.join(", ", tab) ;
System.out.println(s) ;
```

And it prints:

```
> one, two, three
```

Numbers

Numbers: new methods

Method max, min, sum

```
// max method available on number wrapper classes
long max = Long.max(1L, 2L);
long sum = Long.sum(1L, 2L);
```

Numbers: new methods

Method max, min, sum

```
// max method available on number wrapper classes
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```

Is it really *that* useful?

Numbers: new methods

Method max, min, sum

```
// max method available on number wrapper classes
long max = Long.max(1L, 2L);
long sum = Long.sum(1L, 2L);
```

Is it really *that* useful?

```
persons.stream()
       .map(Person::getAge)
       .reduce(0, (a1, a2) -> Integer.max(a1, a2));
```

Numbers: new methods

Method max, min, sum

```
// max method available on number wrapper classes
long max = Long.max(1L, 2L);
long sum = Long.sum(1L, 2L);
```

Is it really *that* useful? Nice to write method references

```
persons.stream()
       .map(Person::getAge)
       .reduce(0, Integer::max);
```

Numbers: new methods

Method max, min, sum

```
// max method available on number wrapper classes
long max = Long.max(1L, 2L);
long sum = Long.sum(1L, 2L);
```

```
persons.stream()
       .mapToInt(Person::getAge)
       .max();
```

Numbers: new methods

Method max, min, sum

```
// max method available on number wrapper classes
long max = Long.max(1L, 2L);
long sum = Long.sum(1L, 2L);
```

```
persons.stream()
       .max(Comparator.comparingBy(Person::getAge));
```

Numbers: new methods

Hashcode computation

```
// JDK 7
long l = 314159265358979323 8L;
int hash =  new Long(l).hashCode(); // -1985256439
```

Numbers: new methods

Hashcode computation

```
// JDK 7
long l = 314159265358979323 8L;
int hash =  new Long(l).hashCode(); // -1985256439
```

```
// JDK 8
long l = 314159265358979323 8L;
int hash =  Long.hashCode(l); // -1985256439
```

I/O

I/O: reading text files

Stream extends AutoCloseable

```
// Java 7 : try with resources and use of Paths
Path path = Paths.get("d:", "tmp", "debug.log");
try (Stream<String> stream = Files.lines(path)) {

   stream.filter(line -> line.contains("ERROR"))
         .findFirst()
         .ifPresent(System.out::println);

} catch (IOException ioe) {
   // handle the exception
}
```

I/O: reading text files

Files.list returns the content of the directory

```
// Java 7 : try with resources and use of Paths
Path path = Paths.get("c:", "windows");
try (Stream<Path> stream = Files.list(path)) {

   stream.filter(path -> path.toFile().isDirectory())
         .forEach(System.out::println);

} catch (IOException ioe) {
   // handle the exception
}
```

I/O: reading a tree of subdirs

Files.walk returns the content of the subtree

```
// Java 7 : try with resources and use of Paths
Path path = Paths.get("c:", "windows");
try (Stream<Path> stream = Files.walk(path)) {

   stream.filter(path -> path.toFile().isDirectory())
         .forEach(System.out::println);

} catch (IOException ioe) {
   // handle the exception
}
```

I/O: reading a tree of subdirs

Files.walk can limit the depth of exploration

```
// Java 7 : try with resources and use of Paths
Path path = Paths.get("c:", "windows");
try (Stream<Path> stream = Files.walk(path, 2)) {

   stream.filter(path -> path.toFile().isDirectory())
         .forEach(System.out::println);

} catch (IOException ioe) {
   // handle the exception
}
```

List

Iterable: forEach

ForEach: consumes the elements

```
// method forEach defined on Iterable
List<String> strings =
   Arrays.asList("one", "two", "three") ;

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

Doesn't work on arrays

```
> one, two, three
```

Collection: removeIf

Removes an object, takes a Predicate

```
Collection<String> strings =
   Arrays.asList("one", "two", "three", "four");

// works « in place », no Collections.unmodifiable...
Collection<String> list = new ArrayList<>(strings);

// returns true if the list has been modified
boolean b = list.removeIf(s -> s.length() > 4);
```

```
> one, two, four
```

List: replaceAll

Replaces an object with its transform

```
List<String> strings =
   Arrays.asList("one", "two", "three", "four");

// works « in place », no Collections.unmodifiable...
List<String> list = new ArrayList<>(strings);

// returns nothing
list.replaceAll(String::toUpperCase);
```

```
> ONE, TWO, THREE, FOUR
```

List: sort

Sorts a List in place, takes a Comparator

```
List<String> strings =
   Arrays.asList("one", "two", "three", "four");

// works « in place », no Collections.unmodifiable...
List<String> list = new ArrayList<>(strings);

// returns nothing
list.sort(Comparator.naturalOrder()) ;
```

```
> four, one, three, two
```

Comparator

Comparator!

What else?

```
Comparator.naturalOrder() ;
```

Comparator!

What else?

```
Comparator.naturalOrder()

public static
   <T extends Comparable<? super T>> Comparator<T> naturalOrder() {
      return (Comparator<T>)
          Comparators.NaturalOrderComparator.INSTANCE;
    }
```

Comparator!

```
enum NaturalOrderComparator
implements Comparator<Comparable<Object>> {

   INSTANCE; // What is this???









}
```

Comparator!

```
enum NaturalOrderComparator
implements Comparator<Comparable<Object>> {

    INSTANCE; // OMG: a s




}
```

```
public class MySingleton {

    INSTANCE;

    private MySingleton() {}

    public static MySingleton getInstance() {
        // some buggy double-checked locking code
        return INSTANCE;
    }
}
```

Comparator!

```
enum NaturalOrderComparator
implements Comparator<Comparable<Object>> {

   INSTANCE;

   public int compare(Comparable<Object> c1, Comparable<Object> c2) {
      return c1.compareTo(c2);
   }



}
```

Comparator!

```
enum NaturalOrderComparator
implements Comparator<Comparable<Object>> {

   INSTANCE;

   public int compare(Comparable<Object> c1, Comparable<Object> c2) {
      return c1.compareTo(c2);
   }

   public Comparator<Comparable<Object>> reversed() {
      return Comparator.reverseOrder();
   }
}
```

Comparator!

The good ol' way!

```
// comparison using the last name
Comparator<Person> compareLastName =
    new Comparator<Person>() {

        @Override
        public int compare(Person p1, Person p2) {
            return p1.getLastName().compareTo(p2.getLastName());
        }
    };
```

Comparator!

```
// comparison using the last name then the first name
Comparator<Person> compareLastNameThenFirstName =
    new Comparator<Person>() {

        @Override
        public int compare(Person p1, Person p2) {
            int lastNameComparison =
                p1.getLastName().compareTo(p2.getLastName());
            return lastNameComparison == 0 ?
                p2.getFirstName().compareTo(p2.getFirstName());
                lastNameComparison;
        }
    };
```

Comparator!

The JDK 8 way!

```
Comparator.comparingBy(Person::getLastName);    // static method
```

Comparator!

The JDK 8 way!

```
Comparator.comparingBy(Person::getLastName)      // static method
          .thenComparing(Person::getFirstName); // default method
```

Comparator!

The JDK 8 way!

```
Comparator.comparingBy(Person::getLastName)      // static method
          .thenComparing(Person::getFirstName)  // default method
          .thenComparing(Person::getAge);
```

Comparator!

Dont like the natural order?

```
Comparator<Person> comp = Comparator.naturalOrder();

Comparator<Person> reversedComp = Comparator.reversedOrder();
```

Comparator!

Dont like the natural order?

```
Comparator<Person> comp = Comparator.comparingBy(Person::getLastName);

Comparator<Person> reversedComp = comp.reversed();
```

Comparator!

And what about null values?

```
Comparator<Person> comp =
    Comparator.naturalOrder();
```

Comparator!

And what about null values?

```
Comparator<Person> comp =
    Comparator.nullsFirst(Comparator.naturalOrder());
```

Comparator!

And what about null values?

```
Comparator<Person> comp =
    Comparator.nullsFirst(Comparator.naturalOrder());

Comparator<Person> comp =
    Comparator.nullsLast(Comparator.naturalOrder());
```


Optional

Optional

Optional has been created to tell that this method could return « no value »

Ex: max(), min()

Optional

Optional has been created to tell that this method could return « no value »

Ex: max(), min(), average()

Optional

An Optional is a wrapping type, that can be empty
How can I build one?

```
Optional<String> opt = Optional.<String>empty() ;
```

```
Optional<String> opt = Optional.of("one") ; // not null
```

```
Optional<String> opt = Optional.ofNullable(s) ; // may be null
```

Optional

An Optional is a wrapping type, that can be empty
How can I use it?

```
Optional<String> opt = ... ;
if (opt.isPresent()) {
   String s = opt.get() ;
} else {
   ...
}
```

Optional

An Optional is a wrapping type, that can be empty
How can I use it?

```
Optional<String> opt = ... ;
if (opt.isPresent()) {
   String s = opt.get() ;
} else {
   ...
}
```

```
String s = opt.orElse("") ; // this is a default value that
                            // is valid for our application
```

Optional

An Optional is a wrapping type, that can be empty
How can I use it?

```
String s = opt.orElseThrow(MyException::new) ; // lazy initialization
```

Optional: more patterns

An Optional can be seen as a special Stream with zero or one element

```
void ifPresent(Consumer<T> consumer) ;
```

Optional: more patterns

An Optional can be seen as a special Stream with zero or one element

```
void ifPresent(Consumer<T> consumer) ;
```

```
Optional<T> filter(Predicate<T> mapper) ;
```

Optional: more patterns

An Optional can be seen as a special Stream with zero or one element

```
void ifPresent(Consumer<T> consumer) ;
```

```
Optional<T> filter(Predicate<T> mapper) ;
```

```
Optional<U> map(Function<T, U> mapper) ;
```

Optional: more patterns

An Optional can be seen as a special Stream with zero or one element

```
void ifPresent(Consumer<T> consumer) ;
```

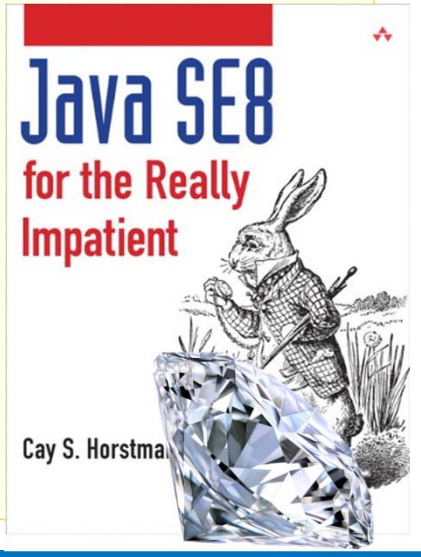
```
Optional<T> filter(Predicate<T> mapper) ;
```

```
Optional<U> map(Function<T, U> mapper) ;
```

```
Optional<U> flatMap(Function<T, Optional<U>> mapper) ;
```

Optional: new patterns sighted!

```
public class NewMath {

   public static Optional<Double> inv(Double d) {

      return d == 0.0d ? Optional.empty() :
                         Optional.of(1/d) ;
   }

   public static Optional<Double> sqrt(Double d) {

      return d < 0.0d ? Optional.empty() :
                        Optional.of(Math.sqrt(d)) ;
   }
}
```



Optional: new patterns sighted!

```
List<Double> doubles = Arrays.asList(-1d, 0d, 1d) ;
List<Double> result = new ArrayList<>() ;

doubles.forEach(
   d1 -> NewMath.inv(d1)                          // Optional<Double>
                .flatMap(d2 -> NewMath.sqrt(d2)) // Optional<Double>
                .ifPresent(result::add)
) ;
```

```
doubles : [-1.0, 0.0, 1.0]
result  : [1.0]
```

Optional: new patterns sighted!

```
List<Double> doubles = Arrays.asList(-1d, 0d, 1d) ;
List<Double> result = new ArrayList<>() ;

doubles.forEach(
   d1 -> NewMath.inv(d1)                          // Optional<Double>
                .flatMap(d2 -> NewMath.sqrt(d2)) // Optional<Double>
                .ifPresent(result::add)
) ;
```

```
doubles : [-1.0, 0.0, 1.0]
result  : [1.0]
```

Optional: new patterns sighted!

```
List<Double> doubles = Arrays.asList(-1d, 0d, 1d) ;
List<Double> result = new ArrayList<>() ;

doubles.forEach(
   d1 -> NewMath.inv(d1)                          // Optional<Double>
                .flatMap(d2 -> NewMath.sqrt(d2)) // Optional<Double>
                .ifPresent(result::add)           // Baaaaad pattern ☹
) ;
```

```
doubles : [-1.0, 0.0, 1.0]
result  : [1.0]
```

Optional: new patterns sighted!

```
Function<Double, Optional<Double>> f =
 d -> NewMath.inv(d)                              // Optional<Double>
             .flatMap(d -> NewMath.sqrt(d))// Optional<Double>
```

Optional: new patterns sighted!

```
d -> NewMath.inv(d)                          // Optional<Double>
             .flatMap(NewMath::sqrt)         // Optional<Double>
             .map(Stream::of)                // Optional<Stream<Double>>
```

Optional: new patterns sighted!

```
d -> NewMath.inv(d)                          // Optional<Double>
              .flatMap(NewMath::sqrt)        // Optional<Double>
              .map(Stream::of)               // Optional<Stream<Double>>
              .orElse(Stream.empty())        // Stream<Double>
```

Optional: new patterns sighted!

```
Function<Double, Stream<Double>> f =
d -> NewMath.inv(d)                          // Optional<Double>
             .flatMap(NewMath::sqrt)         // Optional<Double>
             .map(Stream::of)                // Optional<Stream<Double>>
             .orElse(Stream.empty()) ;       // Stream<Double>
```

Optional: new patterns sighted!

```
List<Double> doubles = Arrays.asList(-1d, 0d, 1d) ;
List<Double> result = new ArrayList<>() ;

doubles.stream()
       .flatMap(
          d -> NewMath.inv(d)                  // Optional<Double>
             .flatMap(NewMath::sqrt)           // Optional<Double>
             .map(Stream::of)                  // Optional<Stream<Double>>
             .orElse(Stream.empty())           // Stream<Double>
       )                                       // Stream<Double>
```

Optional: new patterns sighted!

```
List<Double> doubles = Arrays.asList(-1d, 0d, 1d) ;
List<Double> result = new ArrayList<>() ;

doubles.stream()
       .flatMap(
          d -> NewMath.inv(d)                  // Optional<Double>
             .flatMap(NewMath::sqrt)           // Optional<Double>
             .map(Stream::of)                  // Optional<Stream<Double>>
             .orElse(Stream.empty())           // Stream<Double>
       )                                       // Stream<Double>
       .collect(Collectors.toList()) ;
```

Optional: new patterns sighted!

```
List<Double> doubles = Arrays.asList(-1d, 0d, 1d) ;
List<Double> result = new ArrayList<>() ;

doubles.stream().parallel()
       .flatMap(
          d -> NewMath.inv(d)                  // Optional<Double>
             .flatMap(NewMath::sqrt)           // Optional<Double>
             .map(Stream::of)                  // Optional<Stream<Double>>
             .orElse(Stream.empty())           // Stream<Double>
       )                                       // Stream<Double>
       .collect(Collectors.toList()) ;
```

Map

Map: forEach

Takes a BiConsumer

```
// the existing map
Map<String, Person> map = ... ;

map.forEach(
   (key, value) -> System.out.println(key + " -> " + value)
) ;
```

Map: get

```
// the existing map
Map<String, Person> map = ... ;

Person p = map.get(key);
```

What happens if key is not in the map?

Map: get

```
// the existing map
Map<String, Person> map = ... ;

Person p = map.getOrDefault(key, Person.DEFAULT_PERSON);
```

Map: put

```
// the existing map
Map<String, Person> map = ... ;

map.put(key, person);
```


Map: putIfAbsent

```
// the existing map
Map<String, Person> map = ... ;

map.put(key, person);
map.putIfAbsent(key, person);
```


Map: replace

Replaces a value from its key

```
// the existing map
Map<String, Person> map = ... ;

// key, newValue
map.replace("six", john) ;

// key, oldValue, newValue
map.replace("six", peter, john) ;
```


Map: replaceAll

Replaces all the values from the map, using a λ

```
// the existing map
Map<String, Person> map = ... ;

// key, oldValue
map.replaceAll(
   (key, value) -> key + " -> " + value ;
) ;
```

Map: remove

Removes a key / value pair if it's there

```
// the existing map
Map<String, Person> map = ... ;

// key, oldValue
map.remove("six", john) ;
```

Map: compute

Computes a value from the existing key / value pair and a λ

```
// the existing map
Map<String, Person> map = ... ;

// key, oldValue
map.compute(
    key,
    (key, person) -> key + "::" + person // person can be null
) ;
```

Map: computeIfAbsent

Computes a value from a key that is not in the map

```
// the existing map
Map<String, Person> map = ... ;

// key, no existing value
map.computeIfAbsent(
    key,
    key -> person
) ;
```

Map: computeIfPresent

Computes a value from the existing key / value pair and a λ

```
// the existing map
Map<String, Person> map = ... ;

// key, the existing value
map.computeIfPresent(
    key, person,
    (key, person) -> newPerson // person cannot be null
) ;
```

Map: compute*

The trick is: these methods return the value, whether it was there of just created

Building maps of maps

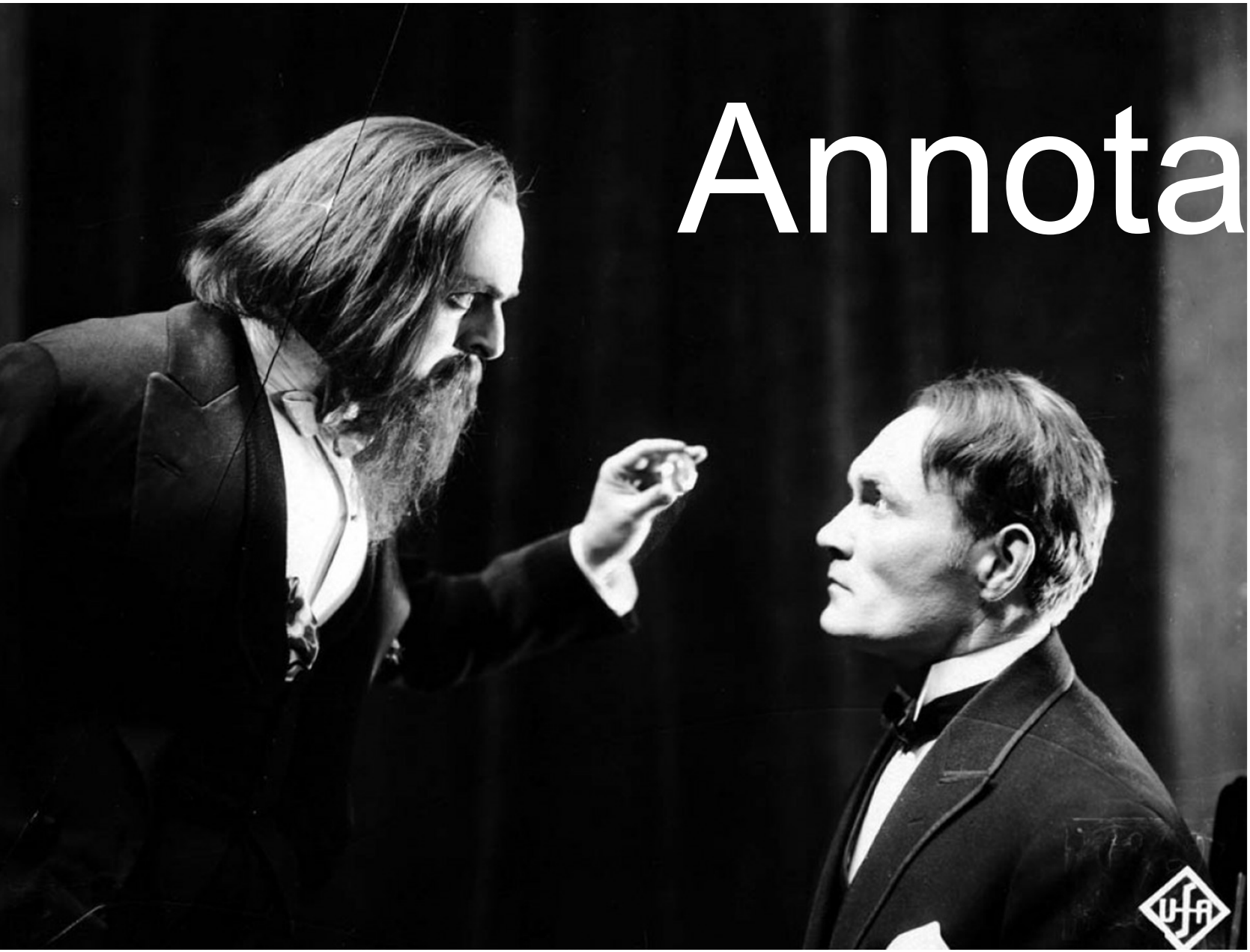
Making maps of maps becomes sooo easy!

```
// the existing map
Map<String, Map<String, Person>> map = ... ;

// key, newValue
map.computeIfAbsent(
    "one",
    (key) -> HashMap::new
).put("two", john);
```

Map: merge

Computes the new value from the existing value, the newly added value and a λ

```
// the existing map
Map<Long, String> map = ... ;

// key, otherValue
map.merge(
    key,
    otherValue,
    (value, otherValue) -> String.join(", ", value, otherValue)
) ;
```



Annotations

Annotations in Java 7

Wrapping annotations

```
@TestCases({
   @TestCase(param=1, expected=false),
   @TestCase(param=2, expected=true)
})
public boolean even(int param) {
   return param % 2 == 0;
}
```

An annotation cannot be applied more than once

Annotations in Java 8

Java 8 makes it possible!

```
@TestCase(param=1, expected=false),
@TestCase(param=2, expected=true)
public boolean even(int param) {
   return param % 2 == 0;
}
```

How does it work?

It’s a trick!

How does it work?

First: create the annotations as usual

```
@interface TestCase {
    int param();
    boolean expected();
}
```

```
@interface TestCases {
    TestCase[] value();
}
```

How does it work?

Second: make the annotation repeatable

```
@Repeatable(TestCases.class)
@interface TestCase {
    int param();
    boolean expected();
}
```

```
@interface TestCases {
    TestCase[] value();
}
```

Type annotations

Annotations can be now put on types

Example 1: tell that a variable should not be null

```
private @NonNull List<Person> persons = ... ;
```

Type annotations

Annotations can be now put on types

Example 1: tell that a variable should not be null

```
private @NonNull List<Person> persons = ... ;
```

Example 2: the content should not be null neither

```
private @NonNull List<@NonNull Person> persons = ... ;
```

Parallel Arrays

Parallel Arrays

Arrays.parallelSetAll

```
long [] array = new long [...] ;

Arrays.parallelSetAll(array, index -> index % 3) ;

System.out.println(Arrays.toString(array)) ;
```

Parallel Arrays

Arrays.parallelPrefix: fold right

```
long [] array = new long [...] ;

Arrays.parallelPrefix(array, (l1, l2) -> l1 + l2) ;

System.out.println(Arrays.toString(array)) ;
```

```
long [] array = {1L, 1L, 1L, 1L} ;

> [1, 2, 3, 4]
```


Parallel Arrays

Arrays.parallelSort: in place sorting

```
long [] array = new long [...] ;

Arrays.parallelSort(array) ;

System.out.println(Arrays.toString(array)) ;
```

CompletableFuture

CompletableFuture

Extension of Future

```
CompletableFuture<String> page =
   CompletableFuture.supplyAsync(


   ) ;
```

CompletableFuture

Extension of Future

```
CompletableFuture<String> page =
   CompletableFuture.supplyAsync(
      () ->
      readWebPage(url) // returns String
   ) ;
```

CompletableFuture

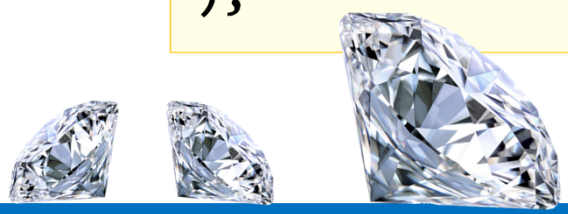
Now we can create pipelines

```
CompletableFuture.supplyAsync(
    () ->
    readWebPage(url)
)
.thenApply(
    content -> getImages(content) // returns a List<Image>
) ; // returns a CompletableFuture<List<Image>>
```

CompletableFuture

Now we can create pipelines

```
CompletableFuture.supplyAsync(
    () ->
    readWebPage(url)
)
.thenApply(
    content -> getImages(content) // returns a List<Image>
)
.thenAccept(
    images -> images.forEach(System.out::println)
);
```



CompletableFuture

thenCompose(): does not wrap the result in a CF

```
CompletableFuture.supplyAsync(
    () ->
    readWebPage(url)
)
.thenCompose(
    content -> getImages(content) // returns List<Image>
)
```

CompletableFuture

allOf: returns when all the tasks are done (see also anyOf)

```
CompletableFuture.allOf(
    CompletableFuture.supplyAsync(
        () ->
        readWebPage(url)
    )
    .thenCompose(content -> getImages(content))
    .thenApply(image -> writeToDisk(image))
)
.join() ;
```

CompletableFuture

thenCombine: can combine more than one CF

```
CompletableFuture cf1 = ... ;
CompletableFuture cf2 = ... ;

cf1.thenCombine(cf2, (b1, b2) -> b1 & b2) ; // can combine
                                            // the results of CFs
```

The λ is applied once the two CF have completed

CompletableFuture

thenCombine: can combine more than one CF

```
CompletableFuture cf1 = ... ;
CompletableFuture cf2 = ... ;

cf1.thenCombine(cf2, (b1, b2) -> b1 & b2) ; // can combine
                                            // the results of CFs
```

The λ is applied once the two CF have completed
Also: thenAcceptBoth, runAfterBoth

CompletableFuture

applyToEither: takes the first available result

```
CompletableFuture cf1 = ... ;
CompletableFuture cf2 = ... ;

cf1.applyToEither(cf2, (b) -> ...) ; // applies to the first
                                     // CF that returns
```

CompletableFuture

applyToEither: takes the first available result

```
CompletableFuture cf1 = ... ;
CompletableFuture cf2 = ... ;

cf1.applyToEither(cf2, (b) -> ...) ; // applies to the first
                                     // CF that returns
```

acceptEither, runAfterEither

Concurrence

Atomic variables

From Java 5:

```
AtomicLong atomic = new AtomicLong() ;
long l1 = atomic.incrementAndGet() ;
```

Atomic variables

Java 8 brings:

```
AtomicLong atomic = new AtomicLong() ;
long l1 = atomic.incrementAndGet() ;

long l2 = atomic.updateAndGet(l -> l*2 + 1) ;
```

Atomic variables

Java 8 brings:

```
AtomicLong atomic = new AtomicLong() ;
long l1 = atomic.incrementAndGet() ;

long l2 = atomic.updateAndGet(l -> l*2 + 1) ;

long l3 = atomic.accumulateAndGet(12L, (l1, l2) -> l1 % l2) ;
```

LongAdder

From Java 8:

```
LongAdder adder = new LongAdder() ;

adder.increment() ; // in a thread
adder.increment() ; // in a 2nd thread
adder.increment() ; // in a 3rd thread

long sum = adder.sum() ;
```

LongAccumulator

Same thing, with λ:

```
LongAccumulator accu =
    new LongAccumulator((l1, l2) -> Long.max(l1, l2), 0L) ;

accu.accumulate(value1) ; // in a thread
accu.accumulate(value2) ; // in a 2nd thread
accu.accumulate(value2) ; // in a 3rd thread

long sum = accu.longValue() ;
```

StampedLock

A regular lock, with optimistic read

```
StampedLock sl= new StampedLock() ;
```

```
long stamp = sl.writeLock() ;
try {
   ...
} finally {
   sl.unlockWrite(stamp) ;
}
```

```
long stamp = sl.readLock() ;
try {
   ...
} finally {
   sl.unlockRead(stamp) ;
}
```

StampedLock

A regular lock, with optimistic read

```
StampedLock sl= new StampedLock() ;
```

```
long stamp = sl.writeLock() ;
try {
   ...
} finally {
   sl.unlockWrite(stamp) ;
}
```

```
long stamp = sl.readLock() ;
try {
   ...
} finally {
   sl.unlockRead(stamp) ;
}
```

Exclusive read / write, but…

StampedLock

A regular lock, with optimistic read

```
StampedLock sl= new StampedLock() ;
```

```
long stamp = sl.tryOptimisticRead() ;
// here we read a variable that can be changed in another thread
if (lock.validate(stamp)) {
   // the read was not concurrent
} else {
   // another thread acquired a write lock
}
```

Concurrent HashMap

ConcurrentHashMap

The old ConcurrentHashMap V7 has been removed
Thread safe
No locking ≠ ConcurrentHashMap V7

New methods (a lot…)

ConcurrentHashMap

6000 lines of code

ConcurrentHashMap

6000 lines of code

54 member classes

ConcurrentHashMap

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54 member classes

FYI: 58 classes in java.util.concurrent

ConcurrentHashMap

6000 lines of code

54 member classes

FYI: 58 classes in java.util.concurrent

New patterns!

ConcurrentHashMap

Forget about size()

```
int   count = map.size() ;          // should not be used

      count = map.mappingCount() ; // new method
```

ConcurrentHashMap

Forget about size()

```
int  count = map.size() ;          // should not be used

long count = map.mappingCount() ; // new method
```

ConcurrentHashMap

Search() method

```
ConcurrentHashMap<Integer, String> map = ... ;

map.search(10L, (key, value) -> value.length() < key) ;
```

search(), searchKey(), searchValue(), searchEntry()

Returns the 1st element that matches the predicate

ConcurrentHashMap

Search() method

```
ConcurrentHashMap<Integer, String> map = ... ;

map.search(10L, (key, value) -> value.length() < key) ;
```

search(), searchKey(), searchValue(), searchEntry()

Returns the 1st element that matches the predicate

ConcurrentHashMap

Search() method

```
ConcurrentHashMap<Integer, String> map = ... ;

map.search(10L, (key, value) -> value.length() < key) ;
```

If there are more than 10 elements, then the search will be conducted in parallel!

ConcurrentHashMap

Search() method

```
ConcurrentHashMap<Integer, String> map = ... ;

map.search(10L, (key, value) -> value.length() < key) ;
```

If there are more than 10 elements, then the search will be conducted in parallel!

One can pass 0 or Long.*MAX_VALUE*

ConcurrentHashMap

ForEach

```
ConcurrentHashMap<Integer, String> map = ... ;

map.forEach(10L,
            (key, value) ->
            System.out.println(String.join(key, "->", value)
) ;
```

forEach(), forEachKey(), forEachEntries()

ConcurrentHashMap

Reduction

```
ConcurrentHashMap<Integer, String> map = ... ;

map.reduce(10L,
           (key, value) -> value.getName(), // transformation
           (name1, name2) -> name1.length() > name2.length() ?
                             name1 : name2) // reduction
) ;
```

reduce(), reduceKey(), reduceEntries()

No ConcurrentHashSet

But…

```
Set<String> set = ConcurrentHashMap.newKeySet() ;
```

No ConcurrentHashSet

But…

```
Set<String> set = ConcurrentHashMap.newKeySet() ;
```

Creates a *concurrent hashmap* in which the values are Boolean.*TRUE*

Acts as a concurrent set


Thank you!


Q/A
#50new8
@JosePaumard