Functional Modern Java

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Streams, lambdas, method references and more…

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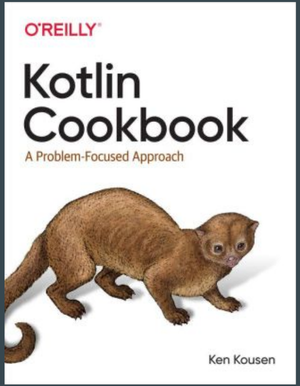
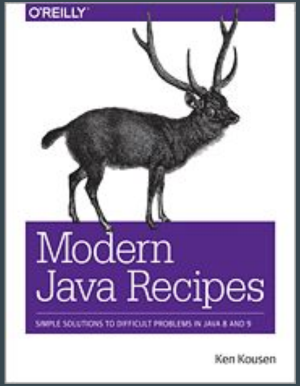
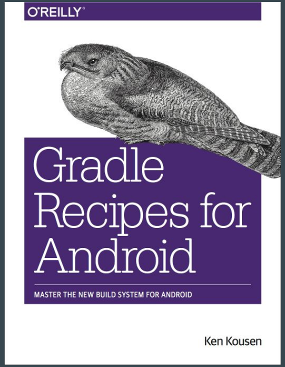
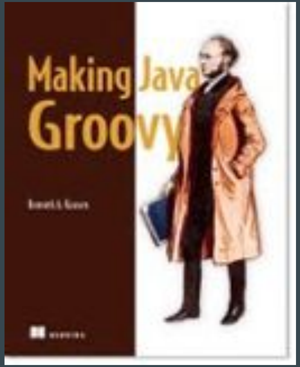





O'REILLY
Gradle Recipes for Android
MASTER THE NEW BUILD SYSTEM FOR ANDROID
Ken Kousen



Videos (available on Safari)

O'Reilly video courses: See http://shop.oreilly.com for details

- Groovy Programming Fundamentals
- Practical Groovy Programming
- Mastering Groovy Programming
- Learning Android
- Practical Android
- Gradle Fundamentals
- Gradle for Android
- Spring Framework Essentials
- Advanced Java Development

Modern Java Recipes

Source code:

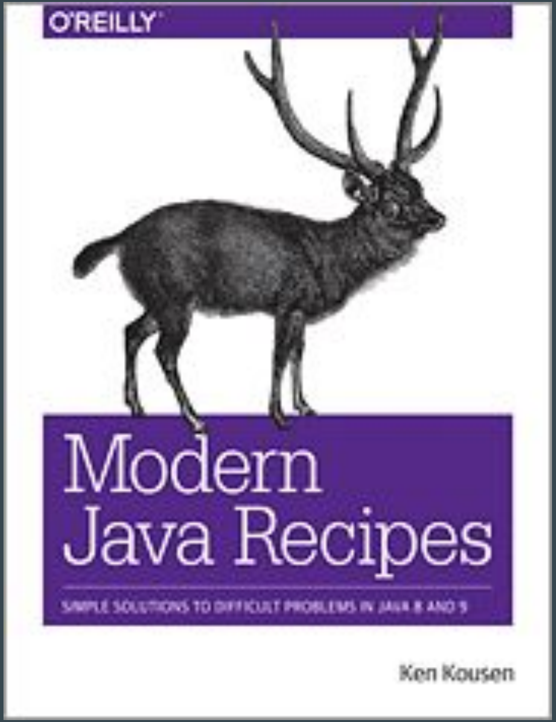
https://github.com/kousen/functional_modern_java

https://github.com/kousen/java_8_recipes

https://github.com/kousen/java_latest

Materials:

http://www.kousenit.com/java8/



The Basics

- Streams
- Lambda Expressions
- Method References

Lambda Expressions

- Java lambda expressions
  - Assigned to Single Abstract Method interfaces
  - Parameter types inferred from context

Functional Interface

Interface with a Single Abstract Method

`Runnable`

Lambdas can only be assigned to

functional interfaces

Functional Interface

See `java.util.function` package

`@FunctionalInterface`

Not required, but useful

Functional Interfaces

Consumer → single arg, no result

```
void accept(T t)
```

Predicate → returns boolean

```
boolean test(T t)
```

Supplier → no arg, returns single result

```
T get()
```

Function → single arg, returns result

```
R apply(T t)
```

Functional Interfaces

Primitive variations

`Consumer`

```
IntConsumer, LongConsumer,
DoubleConsumer,
BiConsumer<T,U>
```

Functional Interfaces

BiFunction → binary function from T and U to R

```
    R apply(T, U)
```

UnaryOperator extends Function (T and R same type)

BinaryOperator extends BiFunction (T, U, and R same type)

Method References

Method references use :: notation

```
System.out::println
    x → System.out.println(x)
Math::max
    (x,y) → Math.max(x,y)
String::length
    x → x.length()
String::compareToIgnoreCase
    (x,y) → x.compareToIgnoreCase(y)
```

Constructor References

Can call constructors

```
ArrayList::new

Person[]::new
```

Default methods

- Default methods in interfaces
  - Use keyword `default`

Default methods

What if there is a conflict?

Class vs Interface → Class always wins

Interface vs Interface →

Child overrides parent

Otherwise compiler error

Static methods in interfaces

- Can add static methods to interfaces
  - See `Comparator.comparing`

Streams

A sequence of elements

- Does not store the elements
- Does not change the source
- Operations are lazy when possible
- Closed when terminal expression reached

Streams

A stream carries values

from a source

through a pipeline

Pipelines

Okay, so what's a pipeline?

- A source
- Zero or more **intermediate** operations
- A **terminal** operation

Reduction Operations

Reduction operations

Terminal operations that produce

one value from a stream

```
average, sum, max, min, count, ...
```

Streams

- Easy to parallelize
    - Replace `stream()` with
        - `parallelStream()`

Creating Streams

Creating streams

```
Collection.stream()

Stream.of(T... values)

Stream.generate(Supplier<T> s)

Stream.iterate(T seed, UnaryOperator<T> f)

Stream.empty()
```

Transforming Streams

Process data from one stream into another

```
filter(Predicate<T> p)

map(Function<T,R> mapper)
```

Transforming Streams

There's also flatMap:

```
Stream<R> flatMap(Function<T, Stream<R>> mapper)
```

Map from single element to multiple elements

Remove internal structure

Substreams

`limit(n)` returns a new stream

ends after n elements

```
DoubleStream.generate(Math::random)
    .limit(100)
    .collect(Collectors.toList())  // 100 random doubles
```

Using Collectors

```
Stream.of( … )

    .collect( Collectors.toList() ) 
```
→ creates an ArrayList

```
    .collect( Collectors.toSet() ) 
```
→ creates a HashSet

```
    .collect( Collectors.toCollection( Supplier ))
```

→ creates the supplier (LinkedList::new, TreeSet::new, etc)

```
    .collect( Collectors.toMap( Function, Function ))
```

→ creates a map; first function is keys, second is values

Optional

Alternative to returning object or null

`Optional<T>` value

- `isPresent()` → boolean
- `get()` → return the value

Goal is to return a default if value is null

Optional

`ifPresent()` accepts a consumer

    `optional.ifPresent(` … do something …)

`orElse()` provides an alternative

    `optional.orElse(`… default …)

```
optional.orElseGet(Supplier<? extends T> other)

optional.orElseThrow(Supplier<? extends X> exSupplier)
```

Deferred execution

- Logging

```
log.info("x = " + x + ", y = " + y);
```

  - String formed even if not info level

```
log.info(() -> "x = " + x + ", y = " + y);
```

  - Only runs if at info level
  - Arg is a `Supplier<String>`

Date and Time API

`java.util.Date` is a disaster

`java.util.Calendar` isn't much better

Now we have `java.time`

LocalDate

A date without time zone info

contains year, month, day of month

```
LocalDate.of(2017, Month.FEBRUARY, 2)
```

months actually count from 1 now

LocalTime

`LocalTime` is just LocalDate for times

hh:mm:ss

`LocalDateTime` is both, but then you

might need time zones

ZonedDateTime

Database of timezones from IANA

https://www.iana.org/time-zones

```
Set<String> ZoneId.getAvailableZoneIds()

ZoneId.of("... tz name ...")
```

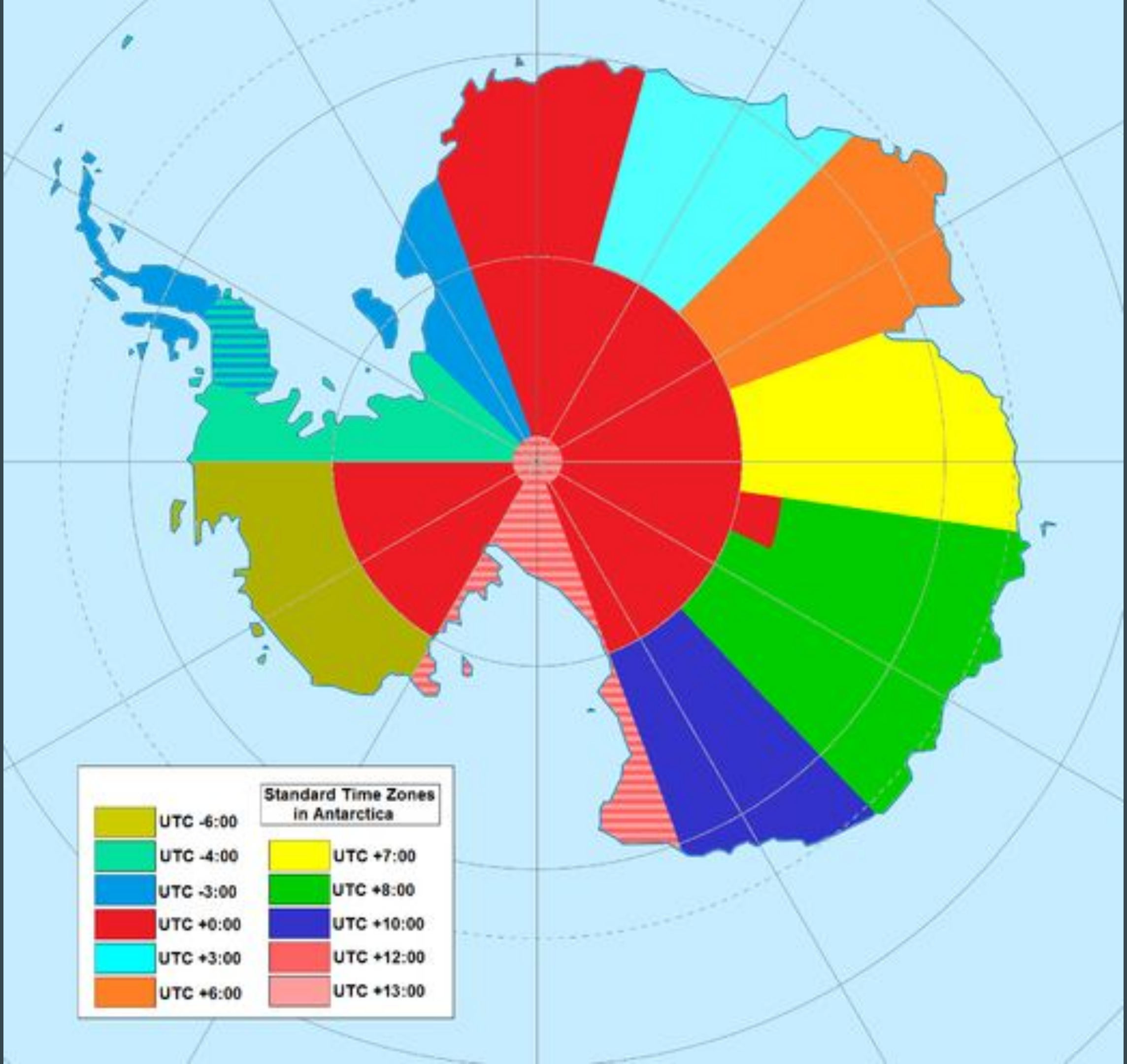
ZonedDateTime

`LocalDateTime` → `ZonedDateTime`

```
local.atZone(zoneId)
```

`Instant` → `ZonedDateTime`

```
instant.atZone(ZoneId.of("UTC"))
```


Standard Time Zones in Antarctica
UTC -6:00
UTC -4:00
UTC -3:00
UTC +0:00
UTC +3:00
UTC +6:00
UTC +7:00
UTC +8:00
UTC +10:00
UTC +12:00
UTC +13:00

Dates and Times

Java 8 Date-Time: java.time package

AntarcticaTimeZones.java

Local Variable Type Inference

The var reserved type name

var Data Type

Local variables only

- No fields
- No method parameters
- No method return types

var is a "reserved type name", not a keyword (can still have variable called "var")

Can also use on

- for loops
- try-with-resources blocks

var Data Type

Stuart Marks: Style Guidelines for Local Variable Type Inference in Java

- http://openjdk.java.net/projects/amber/LVTIstyle.html
- Local variables only

HTTP Client

Built-in sync and async networking

HTTP 2 Client

- New HTTP Client API
    - Supports HTTP/2 and websockets
    - Replaces HTTPURLConnection
- Both synchronous and asynchronous modes

JShell

The Java REPL

JShell

Java interpreter

    https://docs.oracle.com/en/java/javase/11/jshell/introduction-jshell.html

> `jshell` (or add -v for verbose)

jshell>

    /exit to leave

No semicolons needed

Enhanced Switch Statement

Makes switch useable

Enhanced Switch

- Expressions → return a value
- Arrow rather than colon → no fall through
- Multiple case labels
- Statement blocks → yield
- Exhaustive

Text Blocks

Multiline Strings

Text Blocks

- Use "triple double" quotes (""") *and a newline*
- Indentation based on closing """
- `stripIndent`, `indent`, `translateEscapes`

Records

Preview feature of Java 14

Records

- Like a data class → intended to hold data
- Add attributes using constructor syntax
- generates getter methods
- final
- extends java.lang.Record
- generates toString, equals, and hashCode
- can add static fields

Pattern Matching

Preview feature of Java 14

Pattern matching

- Enhances the `instanceof` operator
- `if (shape instanceof Square s)` → use square methods on s
- Like a "smart cast"

Private Methods in Interfaces

Both `default` and `static` methods in interfaces

can call `private` methods

Deprecated Annotation

`@Deprecated` now has fields:

- `forRemoval`
- `since`

Tool `jdeprscan` to scan a jar file for deprecated uses

SafeVarargs

Until Java 8, `@SafeVarargs` could only be applied to:

- static methods
- final methods
- constructors

In Java 9, can add @SafeVarargs to private methods

Summary

- Functional programming
  - Streams with map / filter / reduce
  - Lambda expressions
  - Method references
  - Concurrent, parallel streams
- Optional type
- Collectors and Comparators
  - Conversion from stream back to collections
  - Enable sorting, partitioning, and grouping
- Date/Time API
  - Good reason to upgrade