



# Java SE 8 Best Practices

## A personal viewpoint

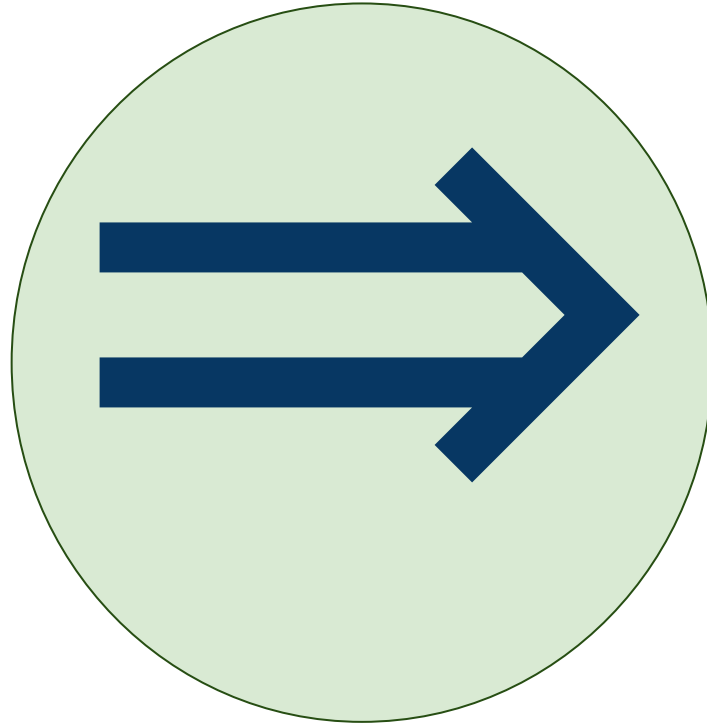
Stephen Colebourne, October 2015



# Agenda

- $\Rightarrow$  Introduction
- $\lambda$  Lambdas
- $f(x)$  Functional interfaces
- ! Exceptions
- ? Optional
- $\rightsquigarrow$  Streams
- I Interfaces
-  Date and Time
-  Extras

# Introduction



# Introduction

- What is a Best Practice?

# Introduction

- What is a Best Practice?

**"commercial or professional procedures  
that are accepted or prescribed as being  
correct or most effective"**

# Introduction

- What is the Best Practice for Java SE 8?

# Introduction

- What is the Best Practice for Java SE 8?

**"whatever I say in the next 50 minutes"**

# Introduction

- Software Best Practice is mostly opinion
- Different conclusions perfectly possible
- My opinions are based on over a year using Java SE 8



# Introduction

- Software Best Practice is mostly opinion
- Different conclusions perfectly possible
- My opinions are based on over a year using Java SE 8

**But you must exercise your own judgement!**

# Java SE 8 version



Best  
Practice

- Use Java SE 8 update 40 or later
  - preferably use the latest available
- Earlier versions have annoying lambda/javac issues

# Lambdas



# Lambdas

- Block of code
  - like an anonymous inner class
- Always assigned to a *Functional Interface*
  - an interface with one abstract method
- Uses *target typing*
  - context determines type of the lambda

# Lambdas - Example

```
// Java 7
List<Person> people = loadPeople();
Collections.sort(people, new Comparator<Person>() {
    @Override
    public int compare(Person p1, Person p2) {
        return p1.name.compareTo(p2.name);
    }
});
```

# Lambdas - Example

```
// Java 7
List<Person> people = loadPeople();
Collections.sort(people, new Comparator<Person>() {
    @Override
    public int compare(Person p1, Person p2) {
        return p1.name.compareTo(p2.name);
    }
});
```

# Lambdas - Example

```
// Java 8
List<Person> people = loadPeople();
Collections.sort(people,
                 (Person p1, Person p2)
                 p1.name.compareTo(p2.name)
);
```

# Lambdas - Example

```
// Java 8  
List<Person> people = loadPeople();  
Collections.sort(people,  
    (Person p1, Person p2) -> p1.name.compareTo(p2.name));
```



# Lambdas - Example

```
// Java 8  
List<Person> people = loadPeople();  
Collections.sort(people,  
    (Person p1, Person p2) -> p1.name.compareTo(p2.name));
```

# Lambdas - Example

```
// Java 8  
List<Person> people = loadPeople();  
Collections.sort(people,  
                (p1, p2) -> p1.name.compareTo(p2.name));
```

# Lambdas - Example

```
// Java 8
```

```
List<Person> people = loadPeople();
```

```
people.sort((p1, p2) -> p1.name.compareTo(p2.name));
```

# Lambdas



Best  
Practice

- Make use of parameter type inference
- Only specify the types when compiler needs it

```
// prefer
```

```
(p1, p2) -> p1.name.compareTo(p2.name);
```

```
// avoid
```

```
(Person p1, Person p2) -> p1.name.compareTo(p2.name);
```

# Lambdas

Best  
Practice

- Do not use parameter brackets when optional

```
// prefer
```

```
str -> str.toUpperCase(Locale.US) ;
```

```
// avoid
```

```
(str) -> str.toUpperCase(Locale.US) ;
```

# Lambdas

Best  
Practice

- Do not declare local variables as 'final'
- Use new "effectively final" concept

```
public UnaryOperator<String> upperCaser(Locale locale) {  
    return str -> str.toUpperCase(locale);  
}
```

Do not declare as 'final'

# Lambdas

Best  
Practice

- Prefer expression lambdas over block lambdas
- Use a separate method if necessary

```
// prefer
str -> str.toUpperCase(Locale.US) ;

// use with care
str -> {
    return str.toUpperCase(Locale.US) ;
}
```

# Lambdas for Abstraction

- Two large methods contain same code
- Except for one bit in the middle
- Can use a lambda to express the difference



# Lambdas for Abstraction

```
private int doFoo() {  
    // lots of code  
    // logic specific to method1  
    // lots of code  
}  
  
private int doBar() {  
    // lots of code  
    // logic specific to method2  
    // lots of code  
}
```

# Lambdas for Abstraction

Best  
Practice

```
private int doFoo() {  
    return doFooBar( lambdaOfFooSpecificLogic );  
}  
  
private int doFooBar(Function<A, B> fn) {  
    // lots of code  
    result = fn.apply(arg)  
    // lots of code  
}
```

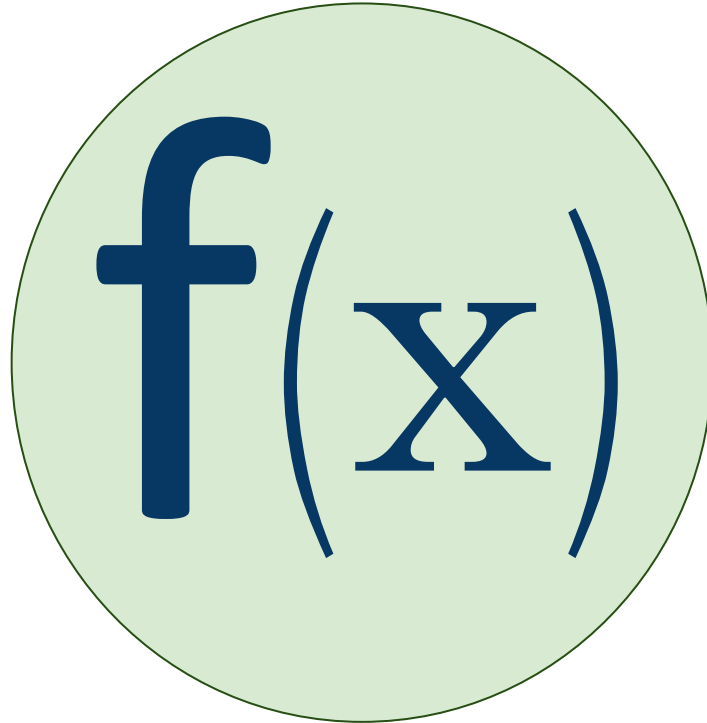
# Example Abstraction

```
double[][] res = new double[rowCount][colCount];
for (int i = 0; i < rowCount; ++i) {
    for (int j = 0; j < colCount; ++j) {
        res[i][j] = pp.getCoefMatrix().get(i, j) * (nCoefs - j - 1);
    }
}
DoubleMatrix2D coef = new DoubleMatrix2D(res);
```

# Example Abstraction

```
DoubleMatrix2D coef = DoubleMatrix2D.of(  
    rowCount,  
    colCount,  
    (i, j) -> pp.getCoefMatrix().get(i, j) * (nCoefs - j - 1));  
  
// new method  
public static DoubleMatrix2D of(  
    int rows, int columns, IntIntToDoubleFunction valueFunction)
```

# Functional interfaces



# Functional interfaces

- An interface with a single abstract method
  - Runnable
  - Comparable
  - Callable
- Java SE 8 adds many new functional interfaces
  - `Function<T, R>`
  - `Predicate<T>`
  - `Supplier<T>`
  - `Consumer<T>`
  - see `java.util.function` package

# Functional interfaces



Best  
Practice

- Learn java.util.function package interface
- Only write your own if extra semantics are valuable
- If writing one, use `@FunctionalInterface`

```
@FunctionalInterface
```

```
public interface FooBarQuery {
```

```
    public abstract Foo findAllFoos (Bar bar) ;
```

```
}
```

# Higher order methods

- Methods accepting lambdas are nothing special
  - declared type is just a normal interface
- However there are some subtleties

```
private String nameGreet(Supplier<String> nameSupplier) {  
    return "Hello " + nameSupplier.get();  
}  
  
// caller can use a lambda  
String greeting = nameGreet(() -> "Bob");
```



# Avoid method overloads

- Lambdas use target typing
- Clashes with method overloading

```
// avoid
public class Foo<T> {
    public Foo<R> apply(Function<T, R> fn);
    public Foo<T> apply(UnaryOperator<T> fn);
}
```

# Avoid method overloads

Best  
Practice

- Lambdas use target typing
- Clashes with method overloading
- Use different method names to avoid clashes

```
// prefer
public class Foo<T> {
    public Foo<R> applyFunction (Function<T, R> fn);
    public Foo<T> applyOperator (UnaryOperator<T> fn);
}
```

# Functional interface last

Best  
Practice

- Prefer to have functional interface last
  - when method takes mixture of FI and non-FI
- Mostly stylistic
  - slightly better IDE error recovery

```
// prefer
```

```
public Foo parse(Locale locale, Function<Locale, Foo> fn);
```

```
// avoid
```

```
public Foo parse(Function<Locale, Foo> fn, Locale locale);
```

# Exceptions



# Checked exceptions

- Most functional interfaces do not declare exceptions
- No simple way to put checked exceptions in lambdas

```
// does not compile!
```

```
public Function<String, Class> loader() {  
    return className -> Class.forName(className);  
}
```

Throws a checked exception

# Checked exceptions



Best  
Practice

- Write or find a helper method
- Converts checked exception to unchecked

```
public Function<String, Class> loader() {  
    return Unchecked.function(  
        className -> Class.forName(className) );  
}
```

# Checked exceptions

- Helper methods can deal with any block of code
  - convert to runtime exceptions
- May be a good case for a block lambda

```
Unchecked.wrap(() -> {  
    // any code that might throw a checked exception  
});
```

# Testing for exceptions

- Complete unit tests often need to test for exceptions

```
public void testConstructorRejectsEmptyString() {  
    try {  
        new FooBar("");  
        fail();  
    } catch (IllegalArgumentException ex) {  
        // expected  
    }  
}
```



# Testing for exceptions

Best  
Practice

- Use a helper method
- Lots of variations on this theme are possible

```
public void testConstructorRejectsEmptyString() {  
    TestHelper.assertThrows(  
        IllegalArgumentException.class, () -> new FooBar("")) ;  
}
```

# Optional and null



Boom!



# Optional and null

- New class 'Optional' added to Java 8
- Polarizes opinions
  - functional programming dudes think it is the saviour of the universe
- Simple concept - two states
  - present, with a value - `Optional.of(foo)`
  - empty - `Optional.empty()`

# Optional and null

- Standard code using null

```
// library, returns null if not found
public Foo findFoo(String key) { ... }

// application code
Foo foo = findFoo(key);
if (foo == null) {
    foo = Foo.DEFAULT; // or throw an exception
}
```

# Optional and null

- Standard code using Optional

```
// library, returns null if not found
public Optional<Foo> findFoo(String key) { ... }

// application code
Foo foo = findFoo(key).orElse(Foo.DEFAULT);
// or
Foo foo = findFoo(key).orElseThrow(RuntimeException::new);
```

# Optional and null



Best  
Practice

- Variable of type Optional must never be null
- Never ever
- Never, never, never, never!

# Optional

Best  
Practice

- Prefer "functional" methods like 'orElse()'
- using 'isPresent()' a lot is misusing the feature

```
// prefer
```

```
Foo foo = findFoo(key).orElse(Foo.DEFAULT);
```

```
// avoid
```

```
Optional<Foo> optFoo = findFoo(key);
```

```
if (optFoo.isPresent()) { ... }
```



# Optional



Best  
Practice

- Have a discussion and choose an approach
  - A. Use everywhere
  - B. Use instead of null on public APIs, input and output
  - C. Use instead of null on public return types
  - D. Use in a few selected places
  - E. Do not use

# Optional



Best  
Practice

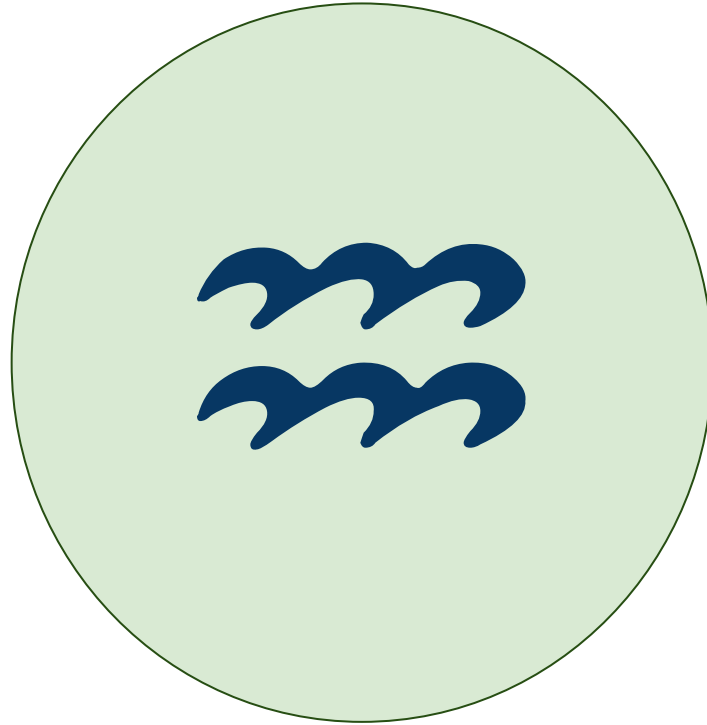
- Have a discussion and choose an approach
  - A. Use everywhere
  - B. Use instead of null on public APIs, input and output
  - C. Use instead of null on public return types
    - ↖ my preferred choice ↗
  - D. Use in a few selected places
  - E. Do not use

# Optional

- Optional is a class
- Some memory/performance cost to using it
- Not serializable
- Not ideal to be an instance variable
- JDK authors added it for return types
- Use in parameters often annoying for callers
- Use as return type gets best value from concept

<http://blog.joda.org/2015/08/java-se-8-optional-pragmatic-approach.html>

# Streams



# Streams

- Most loops are the same
- Repetitive *design patterns*
- Stream library provides an abstraction
- Lambdas used to pass the interesting bits

# Streams

```
List<Trade> trades = loadTrades();  
List<Money> valued = new ArrayList<Money>();  
for (Trade t : trades) {  
    if (t.isActive()) {  
        Money pv = presentValue(t);  
        valued.add(pv);  
    }  
}
```

Loop to build output list from input

Only interested in some trades

Converts each trade to the money value

# Streams

```
List<Trade> trades = loadTrades();  
List<Money> valued = new ArrayList<Money>();  
for (Trade t : trades) {  
    if (t.isActive()) {  
        Money pv = presentValue(t);  
        valued.add(pv);  
    }  
}
```

# Streams

```
List<Trade> trades = loadTrades();  
List<Money> valued = new ArrayList<Money>();  
for (Trade t : trades) {  
    if (t.isActive()) {  
        Money pv = presentValue(t);  
        valued.add(pv);  
    }  
}
```



# Streams

```
List<Trade> trades = loadTrades();  
List<Money> valued = List  
    trades  
    t.isActive()  
    presentValue(t)
```



# Streams

```
List<Trade> trades = loadTrades();  
List<Money> valued = trades.stream().filter(t -> t.isActive()).map(t -> t.presentValue());
```

# Streams

```
List<Trade> trades = loadTrades();  
List<Money> valued =                               // List  
    trades.stream()                                // trades  
        .filter(t -> t.isActive())                // t.isActive()  
        .map(t -> t.presentValue())                // presentValue(t)
```

# Streams

```
List<Trade> trades = loadTrades();  
List<Money> valued =                                     // List  
    trades.stream()                                     // trades  
        .filter(t -> t.isActive())                     // t.isActive()  
        .map(t -> presentValue(t))                       // presentValue(t)
```

# Streams

```
List<Trade> trades = loadTrades();  
List<Money> valued = // List  
    trades.stream() // trades  
        .filter(t -> t.isActive()) // t.isActive()  
        .map(t -> presentValue(t)) // presentValue(t)  
        .collect(Collectors.toList());
```

# Streams

```
List<Trade> trades = loadTrades();  
List<Money> valued =  
    trades.stream()  
        .filter(t -> t.isActive())  
        .map(t -> presentValue(t))  
        .collect(Collectors.toList());
```

# Streams

- Streams are great, sometimes
- Important not to get carried away
- Design focus was on Collections, not Maps
- Key goal was simple parallelism



# Streams

```
List<Trade> trades = loadTrades();  
List<Money> valued =  
    trades.stream()  
        .filter(t -> t.isActive())  
        .map(t -> presentValue(t))  
        .collect(Collectors.toList());
```

# Streams

```
List<Trade> trades = loadTrades();  
List<Money> valued =  
    trades.parallelStream()  
        .filter(t -> t.isActive())  
        .map(t -> presentValue(t))  
        .collect(Collectors.toList());
```

# Streams



Best  
Practice

- Do not overdo it
- Stream not always more readable than loop
- Good for Collections, less so for Maps
- Don't obsess about method references
  - IntelliJ hint may not be the best idea

# Streams



Best  
Practice

- Benchmark use in performance critical sections
- Parallel streams must be used with great care
- Shared execution pool can be deceiving

# Streams



Top  
Tip

- Extract lines if struggling to get to compile

```
List<Trade> trades = loadTrades();  
Predicate<Trade> activePredicate = t -> t.isActive();  
Function<Trade, Money> valueFn = t -> presentValue(t);  
List<Money> valued =  
    trades.stream()  
        .filter(activePredicate)  
        .map(valueFn)  
        .collect(Collectors.toList());
```

# Streams



Top  
Tip

- Sometimes compiler needs a type hint

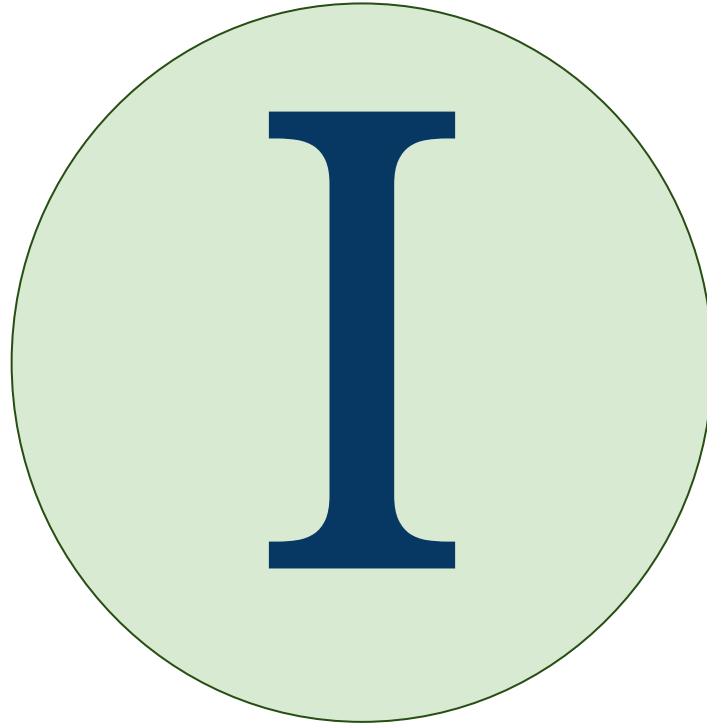
```
List<Trade> trades = loadTrades();
```

```
List<Money> valued =  
    trades.stream()  
        .filter(t.isActive())  
        .map((Trade t) -> presentValue(t))  
        .collect(Collectors.toList());
```

# Streams

- Learn to love 'Collector' interface
- Complex, but useful
- Sometime necessary to write them
- Need collectors for Guava 'ImmutableList' and friends
  - see 'Guavate' class in OpenGamma Strata

# Interfaces





# Interfaces

- Now have super-powers
- Default methods
  - normal method, but on an interface
- Static methods
  - normal static method, but on an interface
- Extend interfaces without breaking compatibility
- Cannot default equals/hashCode/toString

# Interfaces

A starburst-shaped callout box with an orange-to-yellow gradient and a black outline, containing the text "Top Tip" in a bold, dark red font.

**Top  
Tip**

- New macro-design options
- Instead of factory class, use static method on interface
- Instead of abstract class, use interface with defaults
- Result tends to be fewer classes and better API

# Interfaces



Best  
Practice

- If factory method is static on interface
- And all API methods are on interface
- Can implementation class be package scoped?

# Coding Style



Best  
Practice

- Use modifiers in interfaces
- Much clearer now there are different types of method
- Prepares for possible future with non-public methods

```
public interface Foo {  
    public static of(String key) { ... }  
    public abstract getKey();  
    public default isActive() { ... }  
}
```

# Date and Time



# Date and Time

- New Date and Time API - JSR 310
- Covers dates, times, instants, periods, durations
- Brings 80%+ of Joda-Time to the JDK
- Fixes the mistakes in Joda-Time

# Date and Time

Class	Date	Time	ZoneOffset	Zoned	Example
LocalDate	✓	✗	✗	✗	2015-12-03
LocalTime	✗	✓	✗	✗	11:30
LocalDateTime	✓	✓	✗	✗	2015-12-03T11:30
OffsetDateTime	✓	✓	✓	✗	2015-12-03T11:30+01:00
ZonedDateTime	✓	✓	✓	✓	2015-12-03T11:30+01:00 [Europe/London]
Instant	✗	✗	✗	✗	123456789 nanos from 1970-01-01T00:00Z

# Date and Time



Best  
Practice

- Move away from Joda-Time
- Avoid `java.util.Date` and `java.util.Calendar`
- Use ThreeTen-Extra project if necessary
  - <http://www.threeten.org/threeten-extra/>
- Focus on four most useful types
  - `LocalDate`, `LocalTime`, `ZonedDateTime`, `Instant`
- Network formats like XML/JSON use offset types
  - `OffsetTime`, `OffsetDateTime`



# Date and Time

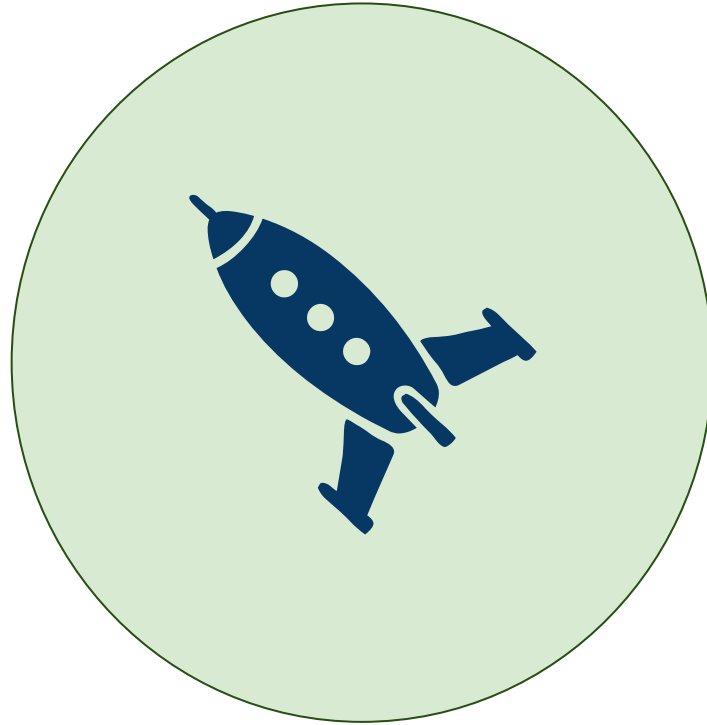
Best  
Practice

- Temporal interfaces are low-level
- Use concrete types

```
// prefer
LocalDate date = LocalDate.of(2015, 10, 15);

// avoid
Temporal date = LocalDate.of(2015, 10, 15);
```

# Rocket powered



# Other features

- Base64
- Arithmetic without numeric overflow
- Unsigned arithmetic
- StampedLock
- CompletableFuture
- LongAdder/LongAccumulator
- Enhanced control of OS processes

# Other Features

- Enhanced annotations
- Reflection on method parameters
- No PermGen in Hotspot JVM
- Nashorn JavaScript
- JavaFX is finally ready to replace Swing

# Try a Java 8 open source library

- JOOL
  - <https://github.com/jOOQ/jOOL>
- ThrowingLambdas
  - <https://github.com/fge/throwing-lambdas>
- Parts of OpenGamma Strata (strata-collect - Guavate)
  - <https://github.com/OpenGamma/Strata>
- But beware excessively functional ones
  - most push ideas that don't really work well in Java

# Immutability

- Favour immutable classes
- Lambdas and streams prefer this
- Preparation for *value types* (Java 10?)
- Use Joda-Beans to generate immutable "beans"
  - <http://www.joda.org/joda-beans/>

# Summary



# Summary

- Java 8 is great
- Can be quite different to Java 7 and earlier
- Vital to rethink coding style and standards
  - methods on interfaces make a big difference
- Beware the functional programming/Scala dudes
  - a lot of their advice is simply not appropriate for Java