

scalafmt: opinionated code formatter for Scala

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Today's agenda

- 1 Introduction
- 2 Background
- 3 scalafmt
- 4 Results
- 5 Conclusion

Overview

1 Introduction

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What is code formatting?

Unformatted

```
object    MyApp
  extends App {
    Initialize ( context, config(port (
      "port.http"),
      settings + custom))
    Loop(  )
  }
```

What is code formatting?

Formatted

```
object MyApp extends App {  
  Initialize(  
    context,  
    config(port("port.http"),  
           settings + custom))  
  Loop()  
}
```

Why?

Reason 1: Collaborative environments

 **sjrd** and 1 other commented on an outdated diff 8 days ago


⚙ Hide comments

...scalajs/testsuite/niobuffer/SupportsTypedArrays.scala

Coverage error

[View full outdated diff](#)

11	12	
12	13	<code>import org.scalajs.testsuite.utils.Platform</code>
13	14	
14	15	<code>trait SupportsTypedArrays {</code>
15	16	<code> @BeforeClass def assumeThatContextSupportsTypedByteArrays(): Unit = {</code>
16		<code>- Assume.assumeTrue(Platform.areTypedArraysSupported)</code>
	17	<code>+ assumeTrue("Typed arrays are supported", Platform.areTypedArraysSupported)</code>

 **sjrd** added a note 8 days ago

Scala.js member



Double space.

Reason 2: Refactoring

Large-Scale Automated Refactoring Using ClangMR¹

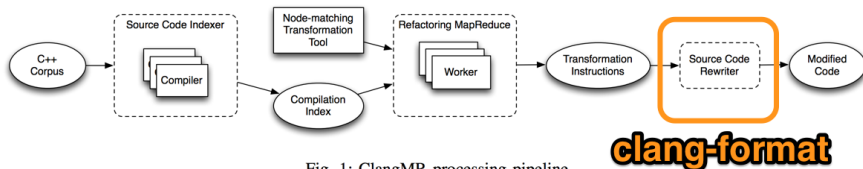


Fig. 1: ClangMR processing pipeline

¹Wright et al. 2013.

Problem statement

What *algorithms* and *data structures* allow us to develop a Scala code formatter with the following features?

- *Maximum line length setting*
- *Opinionated setting*
- *Vertical alignment*
- *Good performance*

Maximum line length setting

```
// 40 character max line length |
object MyApp extends App {
  // BAD
  Initialize(context, config(port("port.http"),
    settings + custom))

  // OK
  Initialize(
    context,
    config(port("port.http"),
      settings + custom))
}
```

Opinionated setting

My definition

Disregard line breaking decisions in the original source to ensure that formatted sources follow a uniform coding style.

```
// Bin-pack
class Point(val x: Int, val y: Int,
            val z: Int)
```

```
// No bin-pack
class Point(val x: Int,
            val y: Int,
            val z: Int)
```

Vertical alignment

```
object VerticalAlignment {  
  x match {  
    case 1  => 1  -> 2  // first  
    case 11 => 11 -> 22 // second  
  }  
  
  def name      = column[String] ("name")  
  def status    = column[Int]    ("status")  
  
  libraryDependencies ++= Seq(  
    "org.scala-lang" % "scala-compiler" % "2.11.7",  
    "com.lihaoyi"    %% "sourcecode"    % "0.1.1"  
  )  
}
```

Performance

- IDEs: reformat file on save
- Build tools: reformat file on compile
- Continuous integration: reformat diff before code review

Overview

1 Introduction

2 Background

- Scalariform (2010)
- ClangFormat (2013)
- rfmt (2016)

3 scalafmt

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Scalariform

- No maximum line length setting
- No opinionated setting

ClangFormat

Parser

- Custom *UnwrappedLine* parser for C, C++, Objective-C, Java, JavaScript and Protobuf²
 - handles invalid code code
 - ~4.000 LOC

```
void f() {  
    someFunction(Parameter1,  
#define A Parameter2  
    A);  
}
```

Diagram illustrating line wrapping in C code:

- line 1: `void f() {`
- line 2: `someFunction(Parameter1,`
- line 3: `#define A Parameter2`
- line 4: `A);`

The diagram shows that lines 1, 2, and 3 are wrapped, while line 4 is not.

²jasper_clang-format_2014.

Line breaking: shortest path search

- Dijkstra's shortest path for optimal line breaking.³
 - Non-whitespace tokens are nodes
 - Whitespace tokens are edges

```

aaaaaaa (aaaaaaaaaaaaa, aaaaaaaaaaaaaa (aaaaaaaaaaaaaaaaaaaaaaaaaaaaa (
                                     aaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaa)),
                                     Penalty: 100
                                     Penalty: 41
aaaaaaa (aaaaaaaaaaaaaaaaaaaaaaaaaaaaa (
                                     aaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaa)));
                                     Penalty: 100
                                     Total: 241

```

³jasper_clang-format_2014.

rfmt

Formatting algebra

- Three layout operators

Lorem ipsum dolor

'txt'

Lorem ipsum dolor
consectetur adipiscing elit

$l_1 \updownarrow l_2$

Lorem ipsum dolor
consectetur adipiscing elit Aliquam erat volutpat
condimentum vitae leo sit

$l_1 \leftrightarrow l_2$

- one *choice* operator “?”

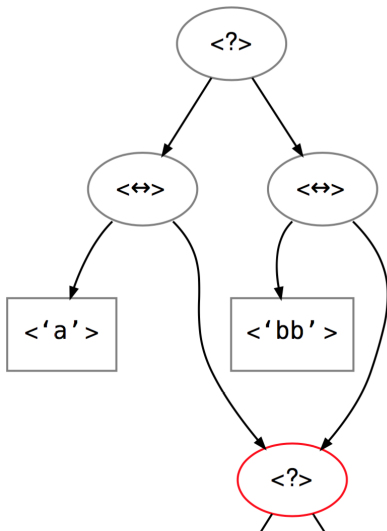
Translating R to formatting algebra

- Custom R parser
 - ~ 1.000 LOC
 - Comments are AST nodes
- “Block language” implemented in terms of primitive combinators

```
ChoiceBlock(  
  LineBlock(LineBlock(TextBlock( $f$ ), TextBlock('(')),  
    WrapBlock( $a_1, \dots, a_m$ ),  
    TextBlock(')'),  
  StackBlock(LineBlock(TextBlock( $f$ ), TextBlock('(')),  
    IndentBlock(4, WrapBlock( $a_1, \dots, a_m$ )),  
    TextBlock('')).
```

Line breaking: dynamic programming

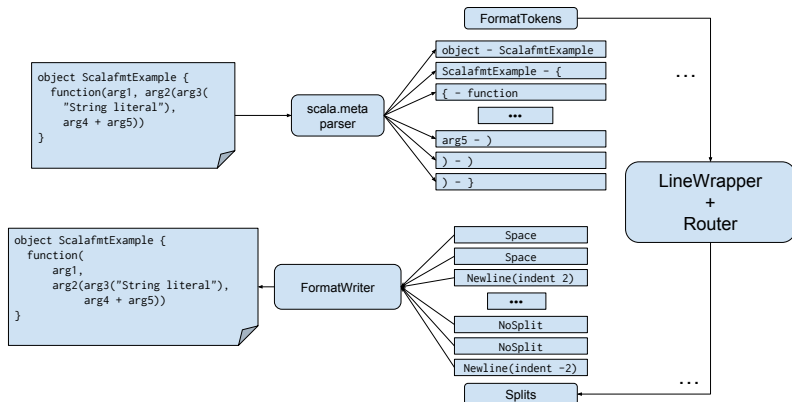
- Dynamic programming to find optimal line breaking
 - (AST node, column) pairs are keys
 - can extrapolate missing columns



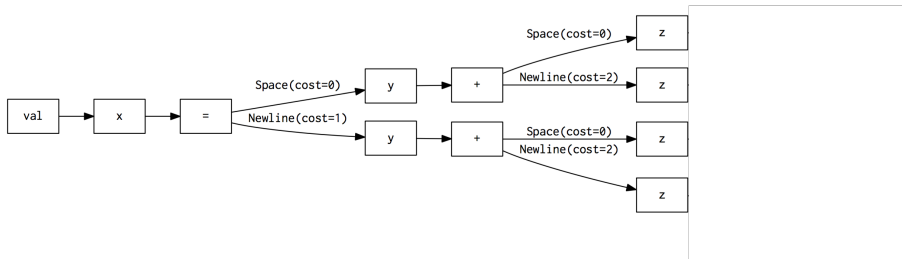
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 - Algorithms
 - Tooling
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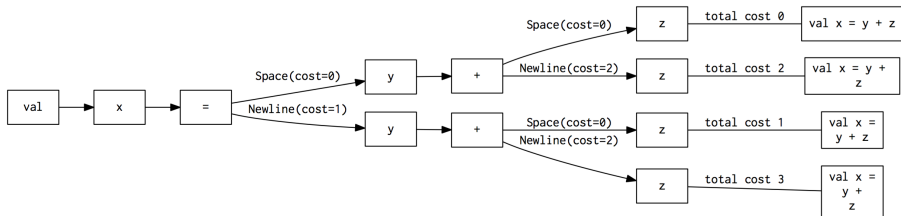
Architecture



LineWrapper + Router



LineWrapper + Router



Plain best-first search

- Small: ~ 20 LOC
- Exponential running time for basic programs

Optimization 1: dequeueOnNewStatements

```
def x = {  
  function1(argument1, argument2, argument3)  
  function2(argument1, argument2, argument3)  
}
```

Optimization 2: OptimalToken

```
Database (UserObject (name1, age1),  
          UserObject (name2, age2),  
          // ...  
          UserObject (nameN, ageN) )
```

Optimization 3: escapeInPathologicalCases

```
Defn.Object (Nil, Term.Name("State"), Template(Nil,  
  Seq(Ctor.Ref.Name("Logger")), Term.Param(Nil,  
    Name.Anonymous(), None, None),  
  Some(Seq(Defn.Val(Nil,  
    Seq(Pat.Var.Term(Term.Name("start"))), None,  
    Term.Apply(Term.Name("State"), Seq()),  
    Defn.Def( /* ... */))))))
```

Tooling

Heatmap

```

2  4  8 16 32 64 128 256
{
  test("add") {
    val blocks: Seq[((Int, Int), Matrix)] =
      Seq(((0, 0), new DenseMatrix(2, 2, Array(1.0, 0.0, 0.0, 2.0))),
          ((0, 1), new DenseMatrix(2, 2, Array(0.0, 1.0, 0.0, 0.0))),
          ((1, 0), new DenseMatrix(2, 2, Array(3.0, 0.0, 1.0, 1.0))),
          ((1, 1), new DenseMatrix(2, 2, Array(1.0, 2.0, 0.0, 1.0))),
          ((2, 0), new DenseMatrix(1, 2, Array(1.0, 0.0))), // This comment will make scalafmt go crazy
          ((2, 1), new DenseMatrix(1, 2, Array(1.0, 5.0))))
    }
  }
}

```


Diff heatmap

2 4 8 16 32 64

```
List(Split(Space,
            0,
            policy = SingleLineBlock(close),
            ignoreIf = blockSize > style.maxColumn),
      Split(nl, 1, policy = {
        case Decision(t@FormatToken(_, `close`, _), s) =>
          Decision(t, List(Split(Newline, 0)))
      })
```

Property 1: can format

```
forall { code =>
  whenever(scalaCompilerCanParse(code)) {
    format(code).asInstanceOf[Success]
  }
}
```

Property 2: can format

```
forAll { code =>  
  ast(code) == ast(format(code))  
}
```

Property 3: idempotent

```
forAll { code =>  
  format(code) == format(format(code))  
}
```

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Verizon

“Verizon is now including scalafmt (with reformat on compile settings) in the default template for all new projects (which, in a sizable microservices shop, is a lot of projects)”

— Daniel Spiewak

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Conclusion

Scalafmt

• ???

The End

Thank you!

References

Wright, Hyrum et al. (2013). “Large-Scale Automated Refactoring Using ClangMR”. In: URL:
<https://research.google.com/pubs/pub41342.html>
(visited on 04/21/2016).