The Patches of the Nopol Automatic Repair System on the Bugs of Defects4J version 1.1.0
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The Patches of the Nopol Automatic Repair System on the Bugs of Defects4J version 1.1.0

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Technical report hal-01480084

\url{https://hal.archives-ouvertes.fr/hal-01480084}

This report lists the test-suite adequate patches found by the Nopol automatic repair system\textsuperscript{3} on version 1.1.0 of the Defects4J benchmark of bugs\textsuperscript{2}. In total, Nopol finds a test-suite adequate patches for 103 different bugs, as shown in Table 1.

To refer to this document:

\begin{verbatim}
@techreport{techrepNopolDefects4j2017,
  TITLE = {{The Patches of the Nopol Automatic Repair System on the Bugs of Defects4J version 1.1.0}},
  AUTHOR = {Durieux, Thomas and Danglot, Benjamin and Zu, Zhongxing and Martinez, Matias and Monperrus, Martin},
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  YEAR = {2017},
  NUMBER = {hal-01480084},
}
\end{verbatim}

We the Oracle JDK 1.7.0 \_7 to run Nopol and OpenJDK 1.8.0 for compiling the project Mockito. We give a time budget of three hours to Nopol to find a patch. The experiment has been conducted on machines that are equipped of Xeon X3440 Quad-core processor and 15GB RAM, the machines are part of the Grid5000 infrastructure\textsuperscript{1}.

Reproduction information:

\begin{itemize}
\item Nopol source code: \url{https://github.com/SpoonLabs/nopol/}
\item Commit used: \url{https://github.com/SpoonLabs/nopol/commit/473b46b2d5c668517bd45be1d87b74858c8934f}
\item Defects4j version: \url{https://github.com/rjust/defects4j/releases/tag/v1.1.0/}
\item Execution traces: \url{https://github.com/Spirals-Team/defects4j-repair/tree/master/results/2017-march/}
\end{itemize}

1 Chart

Nopol repairs 9 bugs in the project Chart.

1.1 Chart 3

```
--- /tmp/chart\_3\_Nopol/source/org/jfree/data/time/TimeSeries.java
+++ /tmp/chart\_3\_Nopol/source/org/jfree/data/time/TimeSeries.java
@@ -884,3 +884,3 @@
  if (removed) {
```

1
Table 1: The number of synthesized test-suite adequate patches for each project.

<table>
<thead>
<tr>
<th>Project</th>
<th># Patches</th>
<th># Bugs</th>
<th>Repair Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chart</td>
<td>9</td>
<td>26</td>
<td>37%</td>
</tr>
<tr>
<td>Closure</td>
<td>56</td>
<td>133</td>
<td>42%</td>
</tr>
<tr>
<td>Lang</td>
<td>4</td>
<td>65</td>
<td>6%</td>
</tr>
<tr>
<td>Math</td>
<td>24</td>
<td>106</td>
<td>22%</td>
</tr>
<tr>
<td>Mockito</td>
<td>2</td>
<td>38</td>
<td>5%</td>
</tr>
<tr>
<td>Time</td>
<td>8</td>
<td>27</td>
<td>29%</td>
</tr>
<tr>
<td>Total</td>
<td>103</td>
<td>395</td>
<td>26%</td>
</tr>
</tbody>
</table>

Listing 1: "The generated patch for the bug Chart 3"

Number of tests that execute the patch: 86
Execution time: 50 seconds

1.2 Chart 4

Listing 2: "The generated patch for the bug Chart 4"

Number of tests that execute the patch: 18
Execution time: 7 minutes, 32 seconds

1.3 Chart 5

Listing 3: "The generated patch for the bug Chart 5"

Number of tests that execute the patch: 6
Execution time: 38 seconds

1.4 Chart 9

Listing 4: "The generated patch for the bug Chart 9"

Number of tests that execute the patch: 4
Execution time: 34 seconds

1.5 Chart 13
```
--- /tmp/chart_13_Nopol/source/org/jfree/chart/block/BorderArrangement.java
+++ /tmp/chart_13_Nopol/source/org/jfree/chart/block/BorderArrangement.java
@@ -452,9 +452,11 @@

 h[3] = h[2];
- if (this.rightBlock != null) {
- RectangleConstraint c4 = new RectangleConstraint(0.0, 
- new Range(0.0, constraint.getWidth() - w[2]), 
- LengthConstraintType.RANGE, h[2], null, 
- LengthConstraintType.FIXED);
- Size2D size = this.rightBlock.arrange(g2, c4);
- w[3] = size.width;
+ if (null != null) {
+ if (this.rightBlock != null) {
+ RectangleConstraint c4 = new RectangleConstraint(0.0, 
+ new Range(0.0, constraint.getWidth() - w[2]), 
+ LengthConstraintType.RANGE, h[2], null, 
+ LengthConstraintType.FIXED);
+ Size2D size = this.rightBlock.arrange(g2, c4);
+ w[3] = size.width;
+ }
 }
```

Listing 5: "The generated patch for the bug Chart 13"

Number of tests that execute the patch: 2
Execution time: 42 seconds

1.6 Chart 17

```
--- /tmp/chart_17_Nopol/source/org/jfree/data/time/TimeSeries.java
+++ /tmp/chart_17_Nopol/source/org/jfree/data/time/TimeSeries.java
@@ -879,3 +879,5 @@

 if (end < start) {
- throw new IllegalArgumentException("Requires start <= end.");
+ if (org.jfree.data.time.TimeSeries.this.data.size() == org.jfree.data.time.
+ TimeSeries.this.range.length()) {
+ throw new IllegalArgumentException("Requires start <= end.");
+ }
+ }
```

Listing 6: "The generated patch for the bug Chart 17"

Number of tests that execute the patch: 4
Execution time: 33 seconds

1.7 Chart 21

```
--- /tmp/chart_21_Nopol/source/org/jfree/data/Range.java
+++ /tmp/chart_21_Nopol/source/org/jfree/data/Range.java
@@ -334,3 +334,5 @@

 if (!(this.lower == range.lower)) {
- return false;
+ if (((1 + org.jfree.data.Range.this.lower) - (-1) < org.jfree.data.Range.this.
+ upper) || (org.jfree.data.Range.this.lower <= 0)) {
+ return false;
+ }
+ }
```

Listing 7: "The generated patch for the bug Chart 21"

Number of tests that execute the patch: 12
Execution time: 37 seconds

1.8 Chart 25

```
--- /tmp/chart_25_Nopol/source/org/jfree/chart/renderer/category/StatisticalBarRenderer.java
+++ /tmp/chart_25_Nopol/source/org/jfree/chart/renderer/category/StatisticalBarRenderer.java
@@ -206,10 +206,12 @@

 PlotOrientation orientation = plot.getOrientation();
- if (orientation == PlotOrientation.HORIZONTAL) {
- drawHorizontalItem(g2, state, dataArea, plot, domainAxis,
- rangeAxis, statData, row, column);
+ if (0 == 1) {
+ if (orientation == PlotOrientation.HORIZONTAL) {
+ drawHorizontalItem(g2, state, dataArea, plot, domainAxis,
+ rangeAxis, statData, row, column);
+ }
+ else if (orientation == PlotOrientation.VERTICAL) {
+ drawVerticalItem(g2, state, dataArea, plot, domainAxis, rangeAxis,
+ statData, row, column);
```

3
else if (orientation == PlotOrientation.VERTICAL) {
    drawVerticalItem(g2, state, dataArea, plot, domainAxis, rangeAxis, statData, row, column);
}

Listing 8: "The generated patch for the bug Chart 25"

Number of tests that execute the patch: 10
Execution time: 33 seconds

1.9 Chart 26

--- /tmp/chart_26_Nopol/source/org/jfree/chart/plot/CategoryPlot.java
+++ /tmp/chart_26_Nopol/source/org/jfree/chart/plot/CategoryPlot.java
@@ -2537,3 +2537,3 @@
    boolean b2 = (area.getHeight() <= MINIMUM_HEIGHT_TO_DRAW);
-    if (b1 || b2) {
-        return;
+    if (org.jfree.chart.plot.CategoryPlot.DEFAULT_CROSSHAIR_STROKE != null) {
+        return;
    }

Listing 9: "The generated patch for the bug Chart 26"

Number of tests that execute the patch: 48
Execution time: 1 minute, 40 seconds

2 Closure

Nopol repairs 56 bugs in the project Closure.

2.1 Closure 1

--- /tmp/closure_1_Nopol/src/com/google/javascript/rhino/Node.java
+++ /tmp/closure_1_Nopol/src/com/google/javascript/rhino/Node.java
@@ -1410,7 +1410,9 @@
    if (diff != null) {
        return "Node tree inequality:
        \nTree1:\n" + toStringTree() +
-            \nTree2:\n" + node2.toStringTree() +
-            \nSubtree1: " + diff.nodeA.toStringTree() +
-            \nSubtree2: " + diff.nodeB.toStringTree();
+            if ((node2.type) != (com.google.javascript.rhino.Node.this.type)) {
+                return "Node tree inequality:
+                \nTree1:\n" + toStringTree() +
+                \nTree2:\n" + node2.toStringTree() +
+                \nSubtree1: " + diff.nodeA.toStringTree() +
+                \nSubtree2: " + diff.nodeB.toStringTree();
+        }
}

Listing 10: "The generated patch for the bug Closure 1"

Number of tests that execute the patch: 15
Execution time: 2 minutes, 4 seconds

2.2 Closure 2

--- /tmp/closure_2_Nopol/src/com/google/javascript/jscomp/TypeCheck.java
+++ /tmp/closure_2_Nopol/src/com/google/javascript/jscomp/TypeCheck.java
@@ -1663,4 +1663,6 @@
        + checkInterfaceConflictsProperties(t, n, functionPrivateName, properties, currentProperties, interfaceType);
+    if (com.google.javascript.jscomp.TypeCheck.this.unknownCount < com.google.javascript.jscomp.TypeCheck.this.typedCount) {
+        checkInterfaceConflictsProperties(t, n, functionPrivateName, properties, currentProperties, interfaceType);
    }

Listing 11: "The generated patch for the bug Closure 2"

Number of tests that execute the patch: 17
Execution time: 2 minutes, 7 seconds

2.3 Closure 3
Listing 12: "The generated patch for the bug Closure 3"

Number of tests that execute the patch: 10
Execution time: 7 minutes, 8 seconds

2.4 Closure 5

Listing 13: "The generated patch for the bug Closure 5"

Number of tests that execute the patch: 8
Execution time: 1 minute, 51 seconds

2.5 Closure 7

Listing 14: "The generated patch for the bug Closure 7"

Number of tests that execute the patch: 358
Execution time: 3 minutes, 26 seconds

2.6 Closure 8
Listing 15: "The generated patch for the bug Closure 8"

Number of tests that execute the patch: 8
Execution time: 2 minutes, 28 seconds

2.7 Closure 10

Listing 16: "The generated patch for the bug Closure 10"

Number of tests that execute the patch: 8
Execution time: 4 minutes, 28 seconds

2.8 Closure 12

Listing 17: "The generated patch for the bug Closure 12"

Number of tests that execute the patch: 8
Execution time: 7 minutes, 35 seconds

2.9 Closure 14

Listing 18: "The generated patch for the bug Closure 14"

Number of tests that execute the patch: 7
2.10 Closure 15

Listing 19: "The generated patch for the bug Closure 15"

Number of tests that execute the patch: 8
Execution time: 7 minutes, 28 seconds

2.11 Closure 16

Listing 20: "The generated patch for the bug Closure 16"

Number of tests that execute the patch: 12
Execution time: 4 minutes, 12 seconds

2.12 Closure 17

Listing 21: "The generated patch for the bug Closure 17"

Number of tests that execute the patch: 25
Execution time: 2 minutes, 1 second

2.13 Closure 18
Listing 22: "The generated patch for the bug Closure 18"

Number of tests that execute the patch: 8
Execution time: 1 minute, 51 seconds

2.14 Closure 20

--- /tmp/closure_20_Nopol/src/com/google/javascript/rhino/Node.java
+++ /tmp/closure_20_Nopol/src/com/google/javascript/rhino/Node.java
@@ -1429,7 +1429,9 @@
    if (diff != null) {
        return "Node tree inequality:" +
          "\nTree1:\n" + toStringTree() +
-          "\nTree2:\n" + node2.toStringTree() +
+          "\nSubtree1: " + diff.nodeA.toStringTree() +
          "\nSubtree2: " + diff.nodeB.toStringTree();
    }
}

Listing 23: "The generated patch for the bug Closure 20"

Number of tests that execute the patch: 8
Execution time: 2 minutes

2.15 Closure 21

--- /tmp/closure_21_Nopol/src/com/google/javascript/jscomp/CheckSideEffects.java
+++ /tmp/closure_21_Nopol/src/com/google/javascript/jscomp/CheckSideEffects.java
@@ -117,7 +117,9 @@
    if (n == parent.getLastChild()) {
      for (Node an : parent.getAncestors()) {
        int ancestorType = an.getType();
-      if (ancestorType == Token.COMMA) continue;
+      if (ancestorType != Token.EXPR_RESULT && ancestorType != Token.BLOCK) return;
        else break;
      }
    }

Listing 24: "The generated patch for the bug Closure 21"

Number of tests that execute the patch: 3
Execution time: 1 minute, 59 seconds

2.16 Closure 22

--- /tmp/closure_22_Nopol/src/com/google/javascript/jscomp/CheckSideEffects.java
+++ /tmp/closure_22_Nopol/src/com/google/javascript/jscomp/CheckSideEffects.java
@@ -115,6 +115,8 @@
    if (ancestorType != Token.EXPR_RESULT && ancestorType != Token.BLOCK) continue;
+    if (ancestorType != Token.EXPR_RESULT && ancestorType != Token.BLOCK) return;
+    else break;
+  }
}

Listing 25: "The generated patch for the bug Closure 22"

Number of tests that execute the patch: 3
2.17 Closure 26

Listing 26: "The generated patch for the bug Closure 26"

Number of tests that execute the patch: 14
Execution time: 3 minutes, 34 seconds

2.18 Closure 28

Listing 27: "The generated patch for the bug Closure 28"

Number of tests that execute the patch: 8
Execution time: 1 minute, 55 seconds

2.19 Closure 29

Listing 28: "The generated patch for the bug Closure 29"

Number of tests that execute the patch: 12
Execution time: 2 minutes

2.20 Closure 30
Listing 29: "The generated patch for the bug Closure 30"

Number of tests that execute the patch: 5
Execution time: 1 minute, 45 seconds

2.21 Closure 31

Listing 30: "The generated patch for the bug Closure 31"

Number of tests that execute the patch: 3
Execution time: 1 minute, 54 seconds

2.22 Closure 33

Listing 31: "The generated patch for the bug Closure 33"

Number of tests that execute the patch: 8
Execution time: 1 minute, 52 seconds

2.23 Closure 35
if ((fieldName.length() != 5)) {
  if (builder.addProperty(fieldName, fieldType, fieldNameNode) == null) {
    // Duplicate field name, warning and skip
    reporter.warning("Duplicate record field "+ fieldName,
        sourceName,
        n.getLineno(), fieldNameNode.getCharno());
  }
}

Listing 32: "The generated patch for the bug Closure 35"

Number of tests that execute the patch: 26
Execution time: 2 minutes, 43 seconds

2.24 Closure 36

if (diff != null) {
  return "Node tree inequality:" +
      "\nTree1: \n" + toStringTree() +
      "\nTree2: \n" + node2.toStringTree() +
      "\nSubtree1: " + diff.nodeA.toStringTree() +
      "\nSubtree2: " + diff.nodeB.toStringTree();
}

Listing 33: "The generated patch for the bug Closure 36"

Number of tests that execute the patch: 3
Execution time: 1 minute, 48 seconds

2.25 Closure 38

boolean negativeZero = isNegativeZero(x);
if (x < 0 && prev == '-') {
  add(" ");
}

Listing 34: "The generated patch for the bug Closure 38"

Number of tests that execute the patch: 1665
Execution time: 3 minutes, 11 seconds

2.26 Closure 40

if (diff != null) {
  return "Node tree inequality:" +
      "\nTree1: \n" + toStringTree() +
      "\nTree2: \n" + node2.toStringTree() +
      "\nSubtree1: " + diff.nodeA.toStringTree() +
      "\nSubtree2: " + diff.nodeB.toStringTree();
}

Listing 35: "The generated patch for the bug Closure 40"
Number of tests that execute the patch: 3
Execution time: 2 minutes, 7 seconds

2.27 Closure 45

```java
--- /tmp/closure_45_Nopol/src/com/google/javascript/rhino/Node.java
+++ /tmp/closure_45_Nopol/src/com/google/javascript/rhino/Node.java
@@ -1403,7 +1403,9 @@
 if (diff != null) {
     return "Node tree inequality:" +
     "\nTree1:\n" + toStringTree() +
-     "\nTree2:\n" + node2.toStringTree() +
-     "\nSubtree1: " + diff.nodeA.toStringTree() +
-     "\nSubtree2: " + diff.nodeB.toStringTree();
+     if (com.google.java.rhino.Node.this.type < 32) {
+         return "Node tree inequality:" +
+         "\nTree1:\n" + toStringTree() +
+         "\nTree2:\n" + node2.toStringTree() +
+         "\nSubtree1: " + diff.nodeA.toStringTree() +
+         "\nSubtree2: " + diff.nodeB.toStringTree();
+     }
}
```

Listing 36: "The generated patch for the bug Closure 45"

Number of tests that execute the patch: 3
Execution time: 1 minute, 41 seconds

2.28 Closure 49

```java
--- /tmp/closure_49_Nopol/src/com/google/javascript/rhino/Node.java
+++ /tmp/closure_49_Nopol/src/com/google/javascript/rhino/Node.java
@@ -1566,7 +1566,9 @@
 if (diff != null) {
     return "Node tree inequality:" +
     "\nTree1:\n" + toStringTree() +
-     "\nTree2:\n" + node2.toStringTree() +
-     "\nSubtree1: " + diff.nodeA.toStringTree() +
-     "\nSubtree2: " + diff.nodeB.toStringTree();
+LABEL_PROP) {
+         return "Node tree inequality:" +
+         "\nTree1:\n" + toStringTree() +
+         "\nTree2:\n" + node2.toStringTree() +
+         "\nSubtree1: " + diff.nodeA.toStringTree() +
+         "\nSubtree2: " + diff.nodeB.toStringTree();
+     }
}
```

Listing 37: "The generated patch for the bug Closure 49"

Number of tests that execute the patch: 68
Execution time: 1 minute, 47 seconds

2.29 Closure 50

```java
--- /tmp/closure_50_Nopol/src/com/google/javascript/rhino/Node.java
+++ /tmp/closure_50_Nopol/src/com/google/javascript/rhino/Node.java
@@ -1566,7 +1566,9 @@
 if (diff != null) {
     return "Node tree inequality:" +
     "\nTree1:\n" + toStringTree() +
-     "\nTree2:\n" + node2.toStringTree() +
-     "\nSubtree1: " + diff.nodeA.toStringTree() +
-     "\nSubtree2: " + diff.nodeB.toStringTree();
+LABEL_PROP) {
+         return "Node tree inequality:" +
+         "\nTree1:\n" + toStringTree() +
+         "\nTree2:\n" + node2.toStringTree() +
+         "\nSubtree1: " + diff.nodeA.toStringTree() +
+         "\nSubtree2: " + diff.nodeB.toStringTree();
+     }
}
```

Listing 38: "The generated patch for the bug Closure 50"

Number of tests that execute the patch: 4
Execution time: 1 minute, 50 seconds

2.30 Closure 55
--- /tmp/closure_55_Nopol/src/com/google/javascript/jscomp/FunctionRewriter.java
+++ /tmp/closure_55_Nopol/src/com/google/javascript/jscomp/FunctionRewriter.java
@@ -92,10 +92,12 @@
       // reductions if doing so will result in some savings.
       if (savings > (helperCodeCost + SAVINGS_THRESHOLD)) {
           for (Reduction reduction : reductions) {
对自己的代码进行简化，根据实际情况来决定是否继续执行。如果简化后节省的量大于辅助代码成本加上节省阈值，那么我们应该遍历所有通过 `reduce` 函数返回的 `Reduction` 对象，并对每个对象应用操作。

```java
+ if((((1) != (reductions.size())) && (!(reducers.size() < reductions.size()))) {
+     if (savings > (helperCodeCost + SAVINGS_THRESHOLD)) {
+         for (Reduction reduction : reductions) {
+             reduction.apply();
+         }
+         Node addingRoot = compiler.getNodeForCodeInsertion(null);
+         addingRoot.addChildrenToFront(helperCode);
+         compiler.reportCodeChange();
+     }
+ }
```

在完成代码简化后，我们通过 `compiler` 获得一个用于插入辅助代码的节点，并将辅助代码添加到该节点的前端。然后，我们报告代码变更。

```java
- Node addingRoot = compiler.getNodeForCodeInsertion(null);
- addingRoot.addChildrenToFront(helperCode);
- compiler.reportCodeChange();
```

在完成代码简化后，我们通过 `compiler` 获得一个用于插入辅助代码的节点，并将辅助代码添加到该节点的前端。然后，我们报告代码变更。

```
Listing 39: "The generated patch for the bug Closure 55"

Number of tests that execute the patch: 11
Execution time: 2 minutes, 14 seconds

2.31 Closure 60

--- /tmp/closure_60_Nopol/src/com/google/javascript/jscomp/PeepholeSubstituteAlternateSyntax.java
+++ /tmp/closure_60_Nopol/src/com/google/javascript/jscomp/PeepholeSubstituteAlternateSyntax.java
@@ -1196,3 +1196,5 @@
       if (!newNode.isEquivalentTo(n)) {
           parent.replaceChild(n, newNode);
           if (com.google.javascript.jscomp.PeepholeSubstituteAlternateSyntax.this.late) {
对自己的代码进行简化，根据实际情况来决定是否继续执行。如果简化后节省的量大于辅助代码成本加上节省阈值，那么我们应该遍历所有通过 `reduce` 函数返回的 `Reduction` 对象，并对每个对象应用操作。

```java
+     if (com.google.javascript.jscomp.PeepholeSubstituteAlternateSyntax.this.late) {
+         parent.replaceChild(n, newNode);
+     }
+     reportCodeChange();
```

在完成代码简化后，我们通过 `compiler` 获得一个用于插入辅助代码的节点，并将辅助代码添加到该节点的前端。然后，我们报告代码变更。

```java
- parent.replaceChild(n, newNode);
- reportCodeChange();
```

在完成代码简化后，我们通过 `compiler` 获得一个用于插入辅助代码的节点，并将辅助代码添加到该节点的前端。然后，我们报告代码变更。

```
Listing 40: "The generated patch for the bug Closure 60"

Number of tests that execute the patch: 31
Execution time: 12 minutes, 12 seconds

2.32 Closure 61

--- /tmp/closure_61_Nopol/src/com/google/javascript/rhino/Node.java
+++ /tmp/closure_61_Nopol/src/com/google/javascript/rhino/Node.java
@@ -1460,7 +1460,9 @@
       if (diff != null) {
           return "Node tree inequality:" +
                   "\n\nTree1:\n" + toStringTree() +
对自己的代码进行简化，根据实际情况来决定是否继续执行。如果简化后节省的量大于辅助代码成本加上节省阈值，那么我们应该遍历所有通过 `reduce` 函数返回的 `Reduction` 对象，并对每个对象应用操作。

```java
+         if ((com.google.javascript.rhino.Node.this.type) != (node2.type)) {
+             return "Node tree inequality:" +
+                     "\n\nTree1:\n" + toStringTree() +
```

在完成代码简化后，我们通过 `compiler` 获得一个用于插入辅助代码的节点，并将辅助代码添加到该节点的前端。然后，我们报告代码变更。

```java
+     "\n\nTree2:\n" + node2.toStringTree() +
+     "\n\nSubtree1: " + diff.nodeA.toStringTree();
```

在完成代码简化后，我们通过 `compiler` 获得一个用于插入辅助代码的节点，并将辅助代码添加到该节点的前端。然后，我们报告代码变更。

```java
+     "\n\nSubtree2: " + diff.nodeB.toStringTree();
```

在完成代码简化后，我们通过 `compiler` 获得一个用于插入辅助代码的节点，并将辅助代码添加到该节点的前端。然后，我们报告代码变更。

```
Listing 41: "The generated patch for the bug Closure 61"

Number of tests that execute the patch: 4
Execution time: 1 minute, 39 seconds

2.33 Closure 62

--- /tmp/closure_62_Nopol/src/com/google/javascript/jscomp/LightweightMessageFormatter.java
+++ /tmp/closure_62_Nopol/src/com/google/javascript/jscomp/LightweightMessageFormatter.java
@@ -96,4 +96,3 @@
       if (excerpt.equals(LINE)) {
           if (excerpt.equals(LINE)) {
             if (excerpt.equals(LINE)) {
对自己的代码进行简化，根据实际情况来决定是否继续执行。如果简化后节省的量大于辅助代码成本加上节省阈值，那么我们应该遍历所有通过 `reduce` 函数返回的 `Reduction` 对象，并对每个对象应用操作。

```java
-     if (excerpt.equals(LINE)) {
-         if (excerpt.equals(LINE)) {
-             if (excerpt.equals(LINE)) {
```

在完成代码简化后，我们通过 `compiler` 获得一个用于插入辅助代码的节点，并将辅助代码添加到该节点的前端。然后，我们报告代码变更。

```java
-     if (excerpt.equals(LINE)) {
-         if (excerpt.equals(LINE)) {
-             if (excerpt.equals(LINE)) {
```

在完成代码简化后，我们通过 `compiler` 获得一个用于插入辅助代码的节点，并将辅助代码添加到该节点的前端。然后，我们报告代码变更。

```java
-     if (excerpt.equals(LINE)) {
-         if (excerpt.equals(LINE)) {
-             if (excerpt.equals(LINE)) {
```

在完成代码简化后，我们通过 `compiler` 获得一个用于插入辅助代码的节点，并将辅助代码添加到该节点的前端。然后，我们报告代码变更。

```java
-     if (excerpt.equals(LINE)) {
-         if (excerpt.equals(LINE)) {
-             if (excerpt.equals(LINE)) {
```

在完成代码简化后，我们通过 `compiler` 获得一个用于插入辅助代码的节点，并将辅助代码添加到该节点的前端。然后，我们报告代码变更。

```java
Listing 42: "The generated patch for the bug Closure 62"

Number of tests that execute the patch: 4
Execution time: 1 minute, 39 seconds
if (error != null) {
    for (int i = 0; i < charno; i++) {
Listing 42: "The generated patch for the bug Closure 62"

Number of tests that execute the patch: 5
Execution time: 1 minute, 32 seconds

2.34 Closure 63

Number of tests that execute the patch: 5
Execution time: 1 minute, 31 seconds

2.35 Closure 66

Number of tests that execute the patch: 166
Execution time: 2 minutes, 21 seconds

2.36 Closure 67

Number of tests that execute the patch: 2
Execution time: 1 minute, 37 seconds

2.37 Closure 72
Listing 46: "The generated patch for the bug Closure 72"

Number of tests that execute the patch: 2
Execution time: 1 minute, 32 seconds

2.38 Closure 75

@@ -1410 ,3 +1410 ,5 @@
- res = n. checkTreeEqualsImpl (n2);
+ this.first.getType()) {
+ res = n. checkTreeEqualsImpl (n2);
+ }
if (res != null) {

Listing 47: "The generated patch for the bug Closure 75"

Number of tests that execute the patch: 3164
Execution time: 24 minutes, 1 second

2.39 Closure 76

@@ -1368 ,7 +1368 ,9 @@
if (diff != null) {
- return " Node tree inequality: "+
- "\n\nTree1: \n" + toStringTree () +
- "\n\nTree2: \n" + node2.toStringTree () +
- "\n\nSubtree1: " + diff.nodeA.toStringTree () +
- "\n\nSubtree2: " + diff.nodeB.toStringTree ();
+ if (node2.type < com.google.javascript.rhino.Node.FUNCTION_PROP) {
+ return " Node tree inequality: "+
+ "\n\nTree1: \n" + toStringTree () +
+ "\n\nTree2: \n" + node2.toStringTree () +
+ "\n\nSubtree1: " + diff.nodeA.toStringTree () +
+ "\n\nSubtree2: " + diff.nodeB.toStringTree ();
+ }
   }
}

Listing 48: "The generated patch for the bug Closure 76"

Number of tests that execute the patch: 5
Execution time: 1 minute, 30 seconds

2.40 Closure 78

@@ -717 ,3 +717 ,5 @@
if ( rval == 0 ) {
- error(DiagnosticType.error("JSC_DIVIDE_BY_0_ERROR", "Divide by 0"), right);
+ if (53 == 0) {
+ error(DiagnosticType.error("JSC_DIVIDE_BY_0_ERROR", "Divide by 0"), right);
+ }
   return null;

Listing 49: "The generated patch for the bug Closure 78"

Number of tests that execute the patch: 1
Execution time: 1 minute, 25 seconds

2.41 Closure 111

@@ -102 ,3 +102 ,3 @@
(a == null) == (b == null));
- if (a == null) {
+ if (a == null) {

15
Listing 50: "The generated patch for the bug Closure 111"

Number of tests that execute the patch: 381
Execution time: 2 minutes, 49 seconds

2.42 Closure 113

Listing 51: "The generated patch for the bug Closure 113"

Number of tests that execute the patch: 26
Execution time: 2 minutes, 22 seconds

2.43 Closure 114

Listing 52: "The generated patch for the bug Closure 114"

Number of tests that execute the patch: 8
Execution time: 2 minutes, 14 seconds

2.44 Closure 115

Listing 53: "The generated patch for the bug Closure 115"

Number of tests that execute the patch: 14
Execution time: 2 minutes, 18 seconds

2.45 Closure 116

Listing 54: "The generated patch for the bug Closure 116"

Number of tests that execute the patch: 14
Execution time: 2 minutes, 18 seconds
Listing 54: "The generated patch for the bug Closure 116"

Number of tests that execute the patch: 13
Execution time: 2 minutes, 13 seconds

2.46 Closure 119

Listing 55: "The generated patch for the bug Closure 119"

Number of tests that execute the patch: 394
Execution time: 32 minutes, 2 seconds

2.47 Closure 120

Listing 56: "The generated patch for the bug Closure 120"

Number of tests that execute the patch: 8
Execution time: 2 minutes, 11 seconds

2.48 Closure 121
Listing 57: "The generated patch for the bug Closure 121"

Number of tests that execute the patch: 8
Execution time: 2 minutes, 12 seconds

2.49 Closure 124

--- /tmp/closure_124_Nopol/src/com/google/javascript/rhino/Node.java
+++ /tmp/closure_124_Nopol/src/com/google/javascript/rhino/Node.java
@@ -1427 ,7 +1427 ,9 @@
     if ( diff != null ) {
         return "Node tree inequality:" +
        - "\nTree1:\n" + toStringTree() +
        - "\nTree2:\n" + node2.toStringTree() +
        - "\nSubtree1: " + diff.nodeA.toStringTree() +
        - "\nSubtree2: " + diff.nodeB.toStringTree();
     + if (node2.type < com.google.javascript.rhino.Node.SIDE_EFFECT_FLAGS) {
     +     return "Node tree inequality:" +
     +        - "\nTree1:\n" + toStringTree() +
     +        - "\nTree2:\n" + node2.toStringTree() +
     +        - "\nSubtree1: " + diff.nodeA.toStringTree() +
     +        - "\nSubtree2: " + diff.nodeB.toStringTree();
     +   }
     }

Listing 58: "The generated patch for the bug Closure 124"

Number of tests that execute the patch: 8
Execution time: 17 minutes, 49 seconds

2.50 Closure 126

--- /tmp/closure_126_Nopol/src/com/google/javascript/jscomp/MinimizeExitPoints.java
+++ /tmp/closure_126_Nopol/src/com/google/javascript/jscomp/MinimizeExitPoints.java
@@ -142 ,3 +142 ,5 @@
    Node finallyBlock = n.getLastChild();
    tryMinimizeExits(finallyBlock, exitType, labelName);
    + if (0 == 1) {
    +     tryMinimizeExits(finallyBlock, exitType, labelName);
    +   }

Listing 59: "The generated patch for the bug Closure 126"

Number of tests that execute the patch: 2
Execution time: 2 minutes, 1 second

2.51 Closure 127

--- /tmp/closure_127_Nopol/src/com/google/javascript/rhino/Node.java
+++ /tmp/closure_127_Nopol/src/com/google/javascript/rhino/Node.java
@@ -1427 ,7 +1427 ,9 @@
     if ( diff != null ) {
         return "Node tree inequality:" +
        - "\nTree1:\n" + toStringTree() +
        - "\nTree2:\n" + node2.toStringTree() +
        - "\nSubtree1: " + diff.nodeA.toStringTree() +
        - "\nSubtree2: " + diff.nodeB.toStringTree();
     + if (node2.type < com.google.javascript.rhino.Node.SIDE_EFFECT_FLAGS) {
     +     return "Node tree inequality:" +
     +        - "\nTree1:\n" + toStringTree() +
     +        - "\nTree2:\n" + node2.toStringTree() +
     +        - "\nSubtree1: " + diff.nodeA.toStringTree() +
     +        - "\nSubtree2: " + diff.nodeB.toStringTree();
     +   }
     }

Listing 60: "The generated patch for the bug Closure 127"

Number of tests that execute the patch: 13
Execution time: 2 minutes, 4 seconds

2.52 Closure 129

18
Listing 61: "The generated patch for the bug Closure 129"

Number of tests that execute the patch: 8
Execution time: 2 minutes, 18 seconds

2.53 Closure 130

Listing 62: "The generated patch for the bug Closure 130"

Number of tests that execute the patch: 8
Execution time: 2 minutes, 3 seconds

2.54 Closure 131

Listing 63: "The generated patch for the bug Closure 131"

Number of tests that execute the patch: 9
Execution time: 2 minutes, 21 seconds

2.55 Closure 132
if (diff != null) {
    return "Node tree inequality:"
    + "\nTree1:\n" + toStringTree() + 
    + "\nTree2:\n" + node2.toStringTree() + 
    + "\nSubtree1: " + diff.nodeA.toStringTree() + 
    + "\nSubtree2: " + diff.nodeB.toStringTree();
}

Listing 64: "The generated patch for the bug Closure 132"

Number of tests that execute the patch: 8
Execution time: 2 minutes, 25 seconds

2.56 Closure 133

Listing 65: "The generated patch for the bug Closure 133"

Number of tests that execute the patch: 254
Execution time: 4 minutes, 22 seconds

3 Lang

Nopol repairs 4 bugs in the project Lang.

3.1 Lang 44

Listing 66: "The generated patch for the bug Lang 44"

Number of tests that execute the patch: 3
Execution time: 29 seconds

3.2 Lang 51
Listing 67: "The generated patch for the bug Lang 51"

Number of tests that execute the patch: 1
Execution time: 28 seconds

3.3 Lang 53

Listing 68: "The generated patch for the bug Lang 53"

Number of tests that execute the patch: 6
Execution time: 35 seconds

3.4 Lang 58

Listing 69: "The generated patch for the bug Lang 58"

Number of tests that execute the patch: 3
Execution time: 10 minutes, 26 seconds

4 Math

Nopol repairs 24 bugs in the project Math.

4.1 Math 2

Listing 70: "The generated patch for the bug Math 2"

Number of tests that execute the patch: 63
Execution time: 6 minutes, 18 seconds

4.2 Math 4
Listing 71: "The generated patch for the bug Math 4"

Number of tests that execute the patch: 24
Execution time: 6 minutes, 7 seconds

4.3 Math 7

Listing 72: "The generated patch for the bug Math 7"

Number of tests that execute the patch: 14
Execution time: 20 minutes, 6 seconds

4.4 Math 24

Listing 73: "The generated patch for the bug Math 24"

Number of tests that execute the patch: 2
Execution time: 9 minutes, 53 seconds

4.5 Math 28

Listing 74: "The generated patch for the bug Math 28"

Number of tests that execute the patch: 4
Execution time: 10 minutes, 31 seconds

4.6 Math 33
+ \text{if (\text{org.apache.commons.math3.optimization.linear.SimplexTableau\_this.} \\
+ \text{numSlackVariables < org.apache.commons.math3.optimization.linear.SimplexTableau\_this.} \\
+ \text{constraints\_size()} \}) \\ + \text{columnsToDrop\_add(i);} \\
+ \text{) }
\}

Listing 75: "The generated patch for the bug Math 33"

Number of tests that execute the patch: 5
Execution time: 9 minutes, 59 seconds

4.7 Math 39

--- /tmp/math_39_Nopol\_src\_main\_java\_org\_apache\_commons\_math\_ode\_nonstiff\/
AdaptiveStepsizeIntegrator.java
+++ /tmp/math_39_Nopol\_src\_main\_java\_org\_apache\_commons\_math\_ode\_nonstiff\/
AdaptiveStepsizeIntegrator.java
@@ -263,3 +263,5 @@
  \text{ratio} = yDot0[j] / scale[j];
- \text{yDotOnScale2} += \text{ratio} \times \text{ratio};
+ \text{if ((scale\_length) \neq (\text{org.apache.commons.math.ode.nonstiff.AdaptiveStepsizeIntegrator.} \\
+ \text{this\_maxStep}))} \\
+ \text{yDotOnScale2} += \text{ratio} \times \text{ratio};
+ \}

Listing 76: "The generated patch for the bug Math 39"

Number of tests that execute the patch: 101
Execution time: 6 minutes, 49 seconds

4.8 Math 40

--- /tmp/math_40_Nopol\_src\_main\_java\_org\_apache\_commons\_math\_analysis\_solvers/
BracketingNthOrderBrentSolver.java
+++ /tmp/math_40_Nopol\_src\_main\_java\_org\_apache\_commons\_math\_analysis\_solvers/
BracketingNthOrderBrentSolver.java
@@ -259,3 +259,3 @@
  \text{// we try again with a lower interpolation order}
- \text{if (signChangeIndex - start >= end - signChangeIndex)} \\
+ \text{if (((signChangeIndex - start) \geq (end - signChangeIndex)) || (xA <= \text{org.} \\
+ \text{apache.commons.math.analysis.solversBracketingNthOrderBrentSolver\_REDUCTION\_FACTOR}))} \\
  \text{// we have more points before the sign change, drop the lowest point}

Listing 77: "The generated patch for the bug Math 40"

Number of tests that execute the patch: 19
Execution time: 10 minutes, 33 seconds

4.9 Math 41

--- /tmp/math_41_Nopol\_src\_main\_java\_org\_apache\_commons\_math\_stat\_descriptive\_moment\_Mean.java
+++ /tmp/math_41_Nopol\_src\_main\_java\_org\_apache\_commons\_math\_stat\_descriptive\_moment\_Mean.java
@@ -216,3 +216,5 @@
  \}
+ \text{if (xbarw < length)} \\
+ \text{return xbarw + (correction/sumw);}
  \}
+ \text{return xbarw + (correction/sumw);}

Listing 78: "The generated patch for the bug Math 41"

Number of tests that execute the patch: 6
Execution time: 4 minutes, 31 seconds

4.10 Math 42

--- /tmp/math_42_Nopol\_src\_main\_java\_org\_apache\_commons\_math\_optimization\_linear\_SimplexTableau.java
+++ /tmp/math_42_Nopol\_src\_main\_java\_org\_apache\_commons\_math\_optimization\_linear\_SimplexTableau.java
@@ -346,3 +346,5 @@
  \text{if (getBasicRow(col) == null)} \\
+ \text{columnsToDrop\_add(col);}
  \text{if (1 <= \text{org.apache.commons.math.optimization.linear.SimplexTableau\_this.} \\
+ \text{numSlackVariables})} \\
+ \text{columnsToDrop\_add(col);}

23
4.11 Math 44

Listing 79: "The generated patch for the bug Math 42"

Number of tests that execute the patch: 16
Execution time: 4 minutes, 39 seconds

Listing 80: "The generated patch for the bug Math 44"

Number of tests that execute the patch: 137
Execution time: 7 minutes, 10 seconds

4.12 Math 49

Listing 81: "The generated patch for the bug Math 49"

Number of tests that execute the patch: 3
Execution time: 3 minutes, 18 seconds

4.13 Math 50

Listing 82: "The generated patch for the bug Math 50"

Number of tests that execute the patch: 118
Execution time: 5 minutes, 37 seconds
Listing 82: "The generated patch for the bug Math 50"

Number of tests that execute the patch: 21
Execution time: 8 minutes, 22 seconds

4.14 Math 57

Listing 83: "The generated patch for the bug Math 57"

Number of tests that execute the patch: 5
Execution time: 3 minutes, 10 seconds

4.15 Math 58

Listing 84: "The generated patch for the bug Math 58"

Number of tests that execute the patch: 10
Execution time: 2 minutes, 54 seconds

4.16 Math 69

Listing 85: "The generated patch for the bug Math 69"

Number of tests that execute the patch: 11
Execution time: 33 seconds

4.17 Math 73
Listing 86: "The generated patch for the bug Math 73"

Number of tests that execute the patch: 5
Execution time: 34 seconds

4.18 Math 78

Listing 87: "The generated patch for the bug Math 78"

Number of tests that execute the patch: 116
Execution time: 15 minutes, 41 seconds

4.19 Math 80

Listing 88: "The generated patch for the bug Math 80"

Number of tests that execute the patch: 1
Execution time: 39 seconds

4.20 Math 81

Listing 89: "The generated patch for the bug Math 81"

Number of tests that execute the patch: 4
Execution time: 40 seconds

4.21 Math 85
if (fa * fb >= 0.0 ) {
  if (maximumIterations == initial) {
    throw new ConvergenceException(
        "number of iterations={0} , maximum iterations={1} , " +
        "initial={2} , lower bound={3} , upper bound={4} , final a value={5} , " +
        "final b value={6} , f(a)={7} , f(b)={8}" ,
        numIterations , maximumIterations , initial ,
        lowerBound , upperBound , a , b , fa , fb);
  }
}

Listing 90: "The generated patch for the bug Math 85"

Number of tests that execute the patch: 17
Execution time: 37 seconds

4.22 Math 87

Listing 91: "The generated patch for the bug Math 87"

Number of tests that execute the patch: 12
Execution time: 50 seconds

4.23 Math 88

Listing 92: "The generated patch for the bug Math 88"

Number of tests that execute the patch: 3
Execution time: 23 seconds

4.24 Math 105

Listing 93: "The generated patch for the bug Math 105"

Number of tests that execute the patch: 9
Execution time: 35 seconds

5 Mockito

Nopol repairs 2 bugs in the project Mockito.
5.1 Mockito 29

```java
--- /tmp/mockito_29_Nopol/src/org/mockito/internal/matchers/Same.java
+++ /tmp/mockito_29_Nopol/src/org/mockito/internal/matchers/Same.java
@@ -28,3 +28,5 @@
     appendQuoting(description);
     if (org.mockito.internal.matchers.Same.this.wanted != null) {
         description.appendText(wanted.toString());
     }
     appendQuoting(description);
```

Listing 94: "The generated patch for the bug Mockito 29"

Number of tests that execute the patch: 5
Execution time: 18 seconds

5.2 Mockito 38

```java
--- /tmp/mockito_38_Nopol/src/org/mockito/internal/matchers/Equals.java
+++ /tmp/mockito_38_Nopol/src/org/mockito/internal/matchers/Equals.java
@@ -19,3 +19,3 @@
 public boolean matches(Object actual) {
     if (this.wanted == null) {
         if (((actual != null) && (actual != null)) {
```

Listing 95: "The generated patch for the bug Mockito 38"

Number of tests that execute the patch: 173
Execution time: 3 minutes, 12 seconds

6 Time

Nopol repairs 8 bugs in the project Time.

6.1 Time 4

```java
--- /tmp/time_4_Nopol/src/main/java/org/joda/time/Partial.java
+++ /tmp/time_4_Nopol/src/main/java/org/joda/time/Partial.java
@@ -458,3 +458,5 @@
     newValues[i] = value;
     if (((20) - (value + newTypes.length) < value) || ((2) != (org.joda.time.Partial.
         this.iTypes.length))) {
```

Listing 96: "The generated patch for the bug Time 4"

Number of tests that execute the patch: 75
Execution time: 56 seconds

6.2 Time 7

```java
--- /tmp/time_7_Nopol/src/main/java/org/joda/time/format/DateTimeParserBucket.java
+++ /tmp/time_7_Nopol/src/main/java/org/joda/time/format/DateTimeParserBucket.java
@@ -358,3 +358,5 @@
         saveField(DateTimeFieldType.year(), iDefaultYear);
             return computeMillis(resetFields, text);
             if (resetFields) {
```

Listing 97: "The generated patch for the bug Time 7"

Number of tests that execute the patch: 84
Execution time: 43 seconds

6.3 Time 11
Listing 98: "The generated patch for the bug Time 11"

Number of tests that execute the patch: 18
Execution time: 53 seconds

6.4 Time 12

Listing 99: "The generated patch for the bug Time 12"

Number of tests that execute the patch: 159
Execution time: 1 minute, 29 seconds

6.5 Time 14

Listing 100: "The generated patch for the bug Time 14"

Number of tests that execute the patch: 63
Execution time: 37 seconds

6.6 Time 16

Number of tests that execute the patch: 63
Execution time: 37 seconds
Listing 101: "The generated patch for the bug Time 16"

Number of tests that execute the patch: 54
Execution time: 40 seconds

6.7 Time 18

--- /tmp/time_18_Nopol/src/main/java/org/joda/time/chrono/BasicChronology.java
+++ /tmp/time_18_Nopol/src/main/java/org/joda/time/chrono/BasicChronology.java
@@ -604,3 +604,5 @@
    FieldUtils.verifyValueBounds(DateTimeFieldType.monthOfYear(), monthOfYear, 1, getMaxMonth(year));
    FieldUtils.verifyValueBounds(DateTimeFieldType.dayOfMonth(), dayOfMonth, 1, getDaysInYearMonth(year, monthOfYear));
+    if (!(10 == monthOfYear)) && (((31) - (2)) != (dayOfMonth)) {
+        FieldUtils.verifyValueBounds(DateTimeFieldType.dayOfMonth(), dayOfMonth, 1, getDaysInYearMonth(year, monthOfYear));
+    }
    return getYearMonthDayMillis(year, monthOfYear, dayOfMonth);

Listing 102: "The generated patch for the bug Time 18"

Number of tests that execute the patch: 3456
Execution time: 7 minutes, 48 seconds

6.8 Time 19

--- /tmp/time_19_Nopol/src/main/java/org/joda/time/DateTimeZone.java
+++ /tmp/time_19_Nopol/src/main/java/org/joda/time/DateTimeZone.java
@@ -899,3 +899,3 @@
    } else if (offsetLocal > 0) {
+        } else if (org.joda.time.DateTimeZone.this.iID!=null) {
+            long prev = previousTransition(instantAdjusted);

Listing 103: "The generated patch for the bug Time 19"

Number of tests that execute the patch: 2139
Execution time: 3 minutes, 24 seconds

References

