


乐在开源

读代码、写代码还有最难忘的那个夏天

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自我介绍

- 北航计算机学院22级硕士生
 - 吴际教授课题组
 - 解构软件需求、解构软件结构
 - 愿景：帮助开发者更快速构造更加稳定、性能更好的程序
-  Buddy Compiler社区贡献者

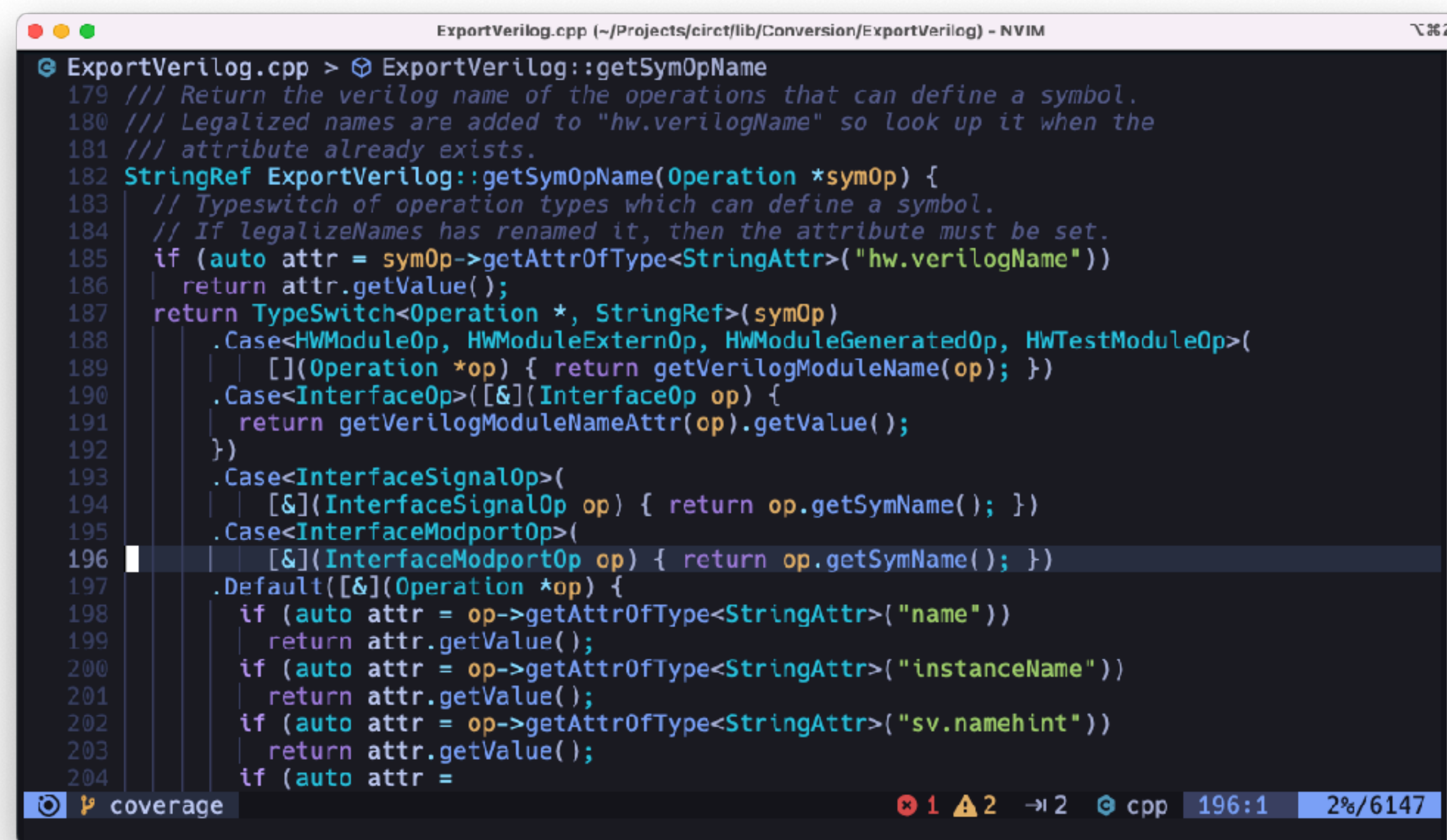
编程迷思

- 我们花费过多时间聚焦于[如何写代码](#)
 - “有读代码的功夫，我都造好新轮子了！”
 - “B站老师教的技术，足够用了！”
 - “想啥呢，遇到问题RTFM/Google/ChatGPT/文心一言[®]，谁会读代码？”
- 写代码 👉 读代码
 - 能力再上一层楼
 - 如果没有详细的文档、遇到ChatGPT没学过的问题.....



你读过代码吗？

- 从头开始读吗？
 - 读不完的
- 这是我认识的C++吗？
 - 读大佬代码，品精彩人生
- 可是我看不懂.....
 - 因为你没有带着任务读！



```
ExportVerilog.cpp (~/Projects/circt/lib/Conversion/ExportVerilog) - NVIM
ExportVerilog.cpp > ExportVerilog::getSymOpName
179 /// Return the verilog name of the operations that can define a symbol.
180 /// Legalized names are added to "hw.verilogName" so look up it when the
181 /// attribute already exists.
182 StringRef ExportVerilog::getSymOpName(Operation *symOp) {
183     // Typeswitch of operation types which can define a symbol.
184     // If legalizeNames has renamed it, then the attribute must be set.
185     if (auto attr = symOp->getAttrOfType<StringAttr>("hw.verilogName"))
186         return attr.getValue();
187     return TypeSwitch<Operation *, StringRef>(symOp)
188         .Case<HWModuleOp, HWModuleExternOp, HWModuleGeneratedOp, HWTestModuleOp>([&](Operation *op) { return getVerilogModuleName(op); })
189         .Case<InterfaceOp>([&](InterfaceOp op) {
190             return getVerilogModuleNameAttr(op).getValue();
191         })
192         .Case<InterfaceSignalOp>([&](InterfaceSignalOp op) { return op.getSymName(); })
193         .Case<InterfaceModportOp>([&](InterfaceModportOp op) { return op.getSymName(); })
194         .Default([&](Operation *op) {
195             if (auto attr = op->getAttrOfType<StringAttr>("name"))
196                 return attr.getValue();
197             if (auto attr = op->getAttrOfType<StringAttr>("instanceName"))
198                 return attr.getValue();
199             if (auto attr = op->getAttrOfType<StringAttr>("sv.namehint"))
200                 return attr.getValue();
201             if (auto attr =
```

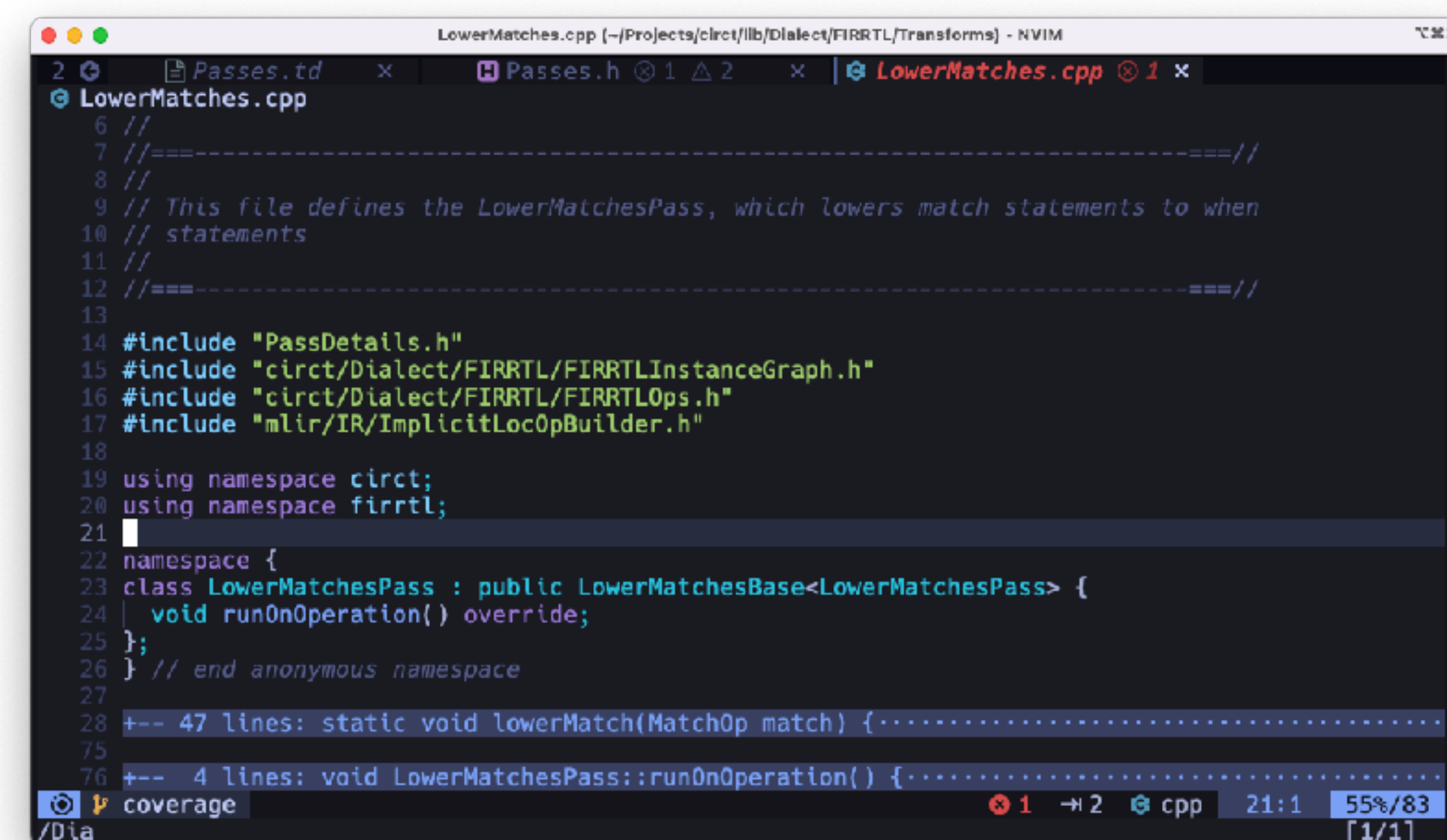
你读过代码吗？

带着任务读代码

- 开源之夏任务丰富
 - 真正的挑战
 - 文档可能是不全的
 - ChatGPT无法替你完成任务（大家在搞一些很新的东西）
 - 需要自己完成任务
- 是时候学会从代码仓库里学东西了！

案例：从单元测试开始看

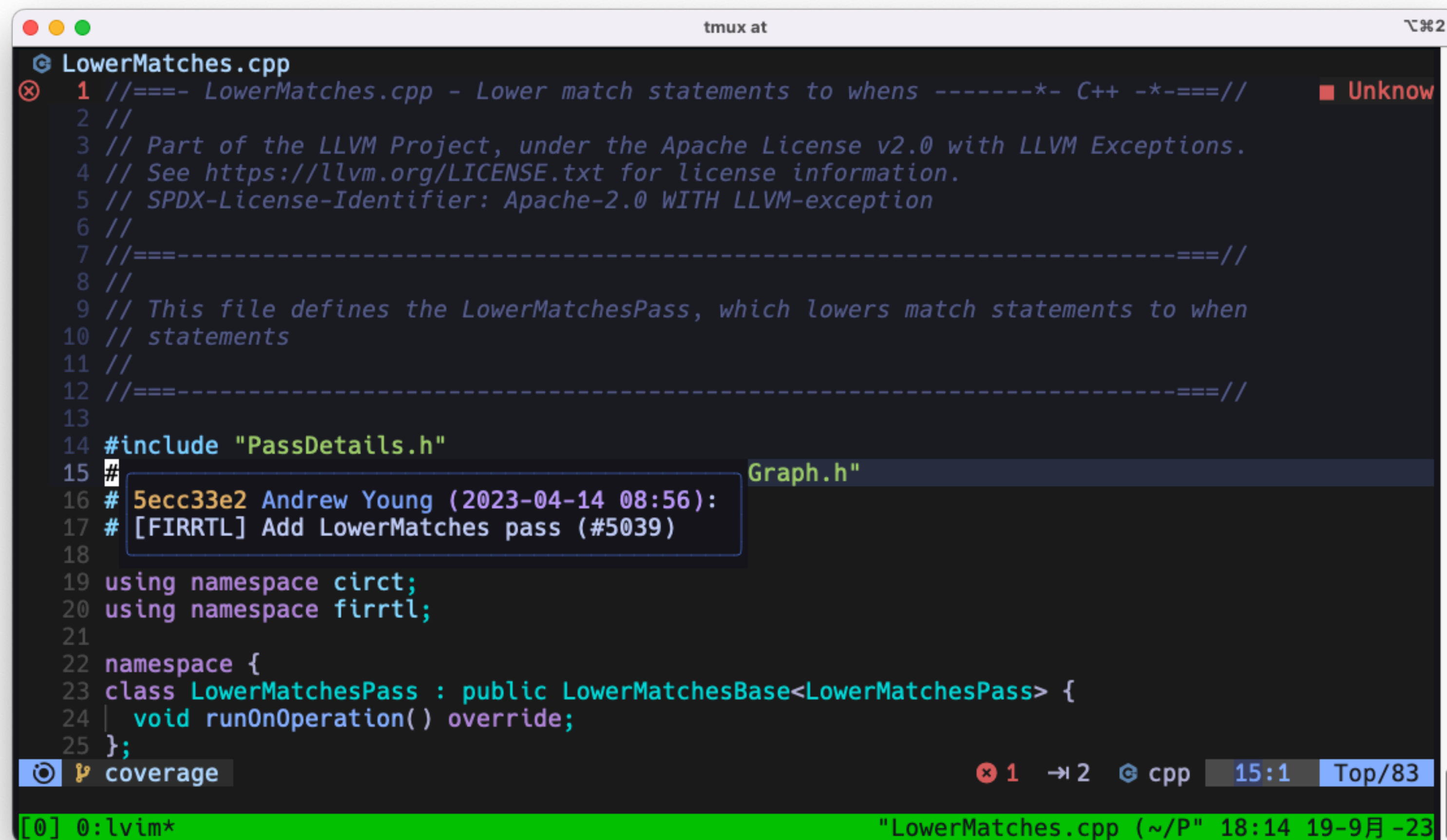
- 我想阅读一下这个Pass是做什么的
 - 前置知识
 - 首先要对被研究对象有些感性认识
- 这个Pass会对输入的程序做一点变换
 - 问题：但是我不知道做了什么变换
- 现在开读吗？Hold On!



```
LowerMatches.cpp [~/Projects/circt/lib/Dialect/FIRRTL/Transforms] - NVIM
2  Passes.td  x  Passes.h 1 2  x  LowerMatches.cpp 1 x
LowerMatches.cpp
6 //
7 //=====//
8 //
9 // This file defines the LowerMatchesPass, which lowers match statements to when
10 // statements
11 //
12 //=====//
13
14 #include "PassDetails.h"
15 #include "circt/Dialect/FIRRTL/FIRRTLInstanceGraph.h"
16 #include "circt/Dialect/FIRRTL/FIRRTLOps.h"
17 #include "mlir/IR/ImplicitLocOpBuilder.h"
18
19 using namespace circt;
20 using namespace firrtl;
21
22 namespace {
23 class LowerMatchesPass : public LowerMatchesBase<LowerMatchesPass> {
24 | void runOnOperation() override;
25 };
26 } // end anonymous namespace
27
28 +-- 47 lines: static void lowerMatch(MatchOp match) {.....}
75
76 +-- 4 lines: void LowerMatchesPass::runOnOperation() {.....}
coverage 1 2 cpp 21:1 55%/83
/Dia [1/1]
```

首先回顾历史

从哪里引入这个变更的？



```
tmux at 2
LowerMatches.cpp
1 //===- LowerMatches.cpp - Lower match statements to whens -----*- C++ -*-===//
2 //
3 // Part of the LLVM Project, under the Apache License v2.0 with LLVM Exceptions.
4 // See https://llvm.org/LICENSE.txt for license information.
5 // SPDX-License-Identifier: Apache-2.0 WITH LLVM-exception
6 //
7 //===-----
8 //
9 // This file defines the LowerMatchesPass, which lowers match statements to when
10 // statements
11 //
12 //===-----
13
14 #include "PassDetails.h"
15 #include "Graph.h"
16 # 5ecc33e2 Andrew Young (2023-04-14 08:56):
17 # [FIRRTL] Add LowerMatches pass (#5039)
18
19 using namespace cirt;
20 using namespace firrtl;
21
22 namespace {
23 class LowerMatchesPass : public LowerMatchesBase<LowerMatchesPass> {
24 | void runOnOperation() override;
25 };
26
27 coverage
28 [0] 0:lvim* "LowerMatches.cpp (~/P" 18:14 19-9月-23
```


首先回顾历史

从哪里引入这个变更的？

[FIRRTL] Add LowerMatches pass (#5039)

Browse files

The lower matches pass transform match statements into when statements. This allows them to be handled by ExpandWhens, including all the fun things it does such as initialization checking. When lowering to when statements, the final case handled by the match is transformed in to the "default" branch and the enumeration tag for this case is not explicitly checked anymore.

The new pass was inserted in to the firtool pipeline right before ExpandWhens runs.

To pass flow checking, we needed to handle teach the `foldFlow` function what to do when the block argument belonged to a match statement. Although the flow should always be `source`, it is returning the accumulated flow in case we relax the restriction that enumeration types are always passive.

main (#5039)

firtool-1.55.0 ... firtool-1.40.0

youngar committed on Apr 14 Verified

1 parent 3451c08 commit becc33e

Showing 7 changed files with 132 additions and 5 deletions.

SplitUnified

Filter changed files

include/circt/Dialect/FIRRTL

Passes.h

Passes.td

lib/Dialect/FIRRTL

FIRRTLOps.cpp

Transforms

CMakeLists.txt

LowerMatches.cpp

test/Dialect/FIRRTL

lower-matches.fir

tools/firtool

firtool.cpp

include/circt/Dialect/FIRRTL/Passes.h

@@ -83,6 +83,8 @@ std::unique_ptr<mlir::Pass> createDedupPass();
83 83 std::unique_ptr<mlir::Pass>
84 84 createEmitOMIRPass(mlir::StringRef outputFilename = "");
85 85
86 86 + std::unique_ptr<mlir::Pass> createLowerMatchesPass();
87 87 +
88 88 std::unique_ptr<mlir::Pass> createExpandWhensPass();
89 89
90 90 std::unique_ptr<mlir::Pass> createFlattenMemoryPass();

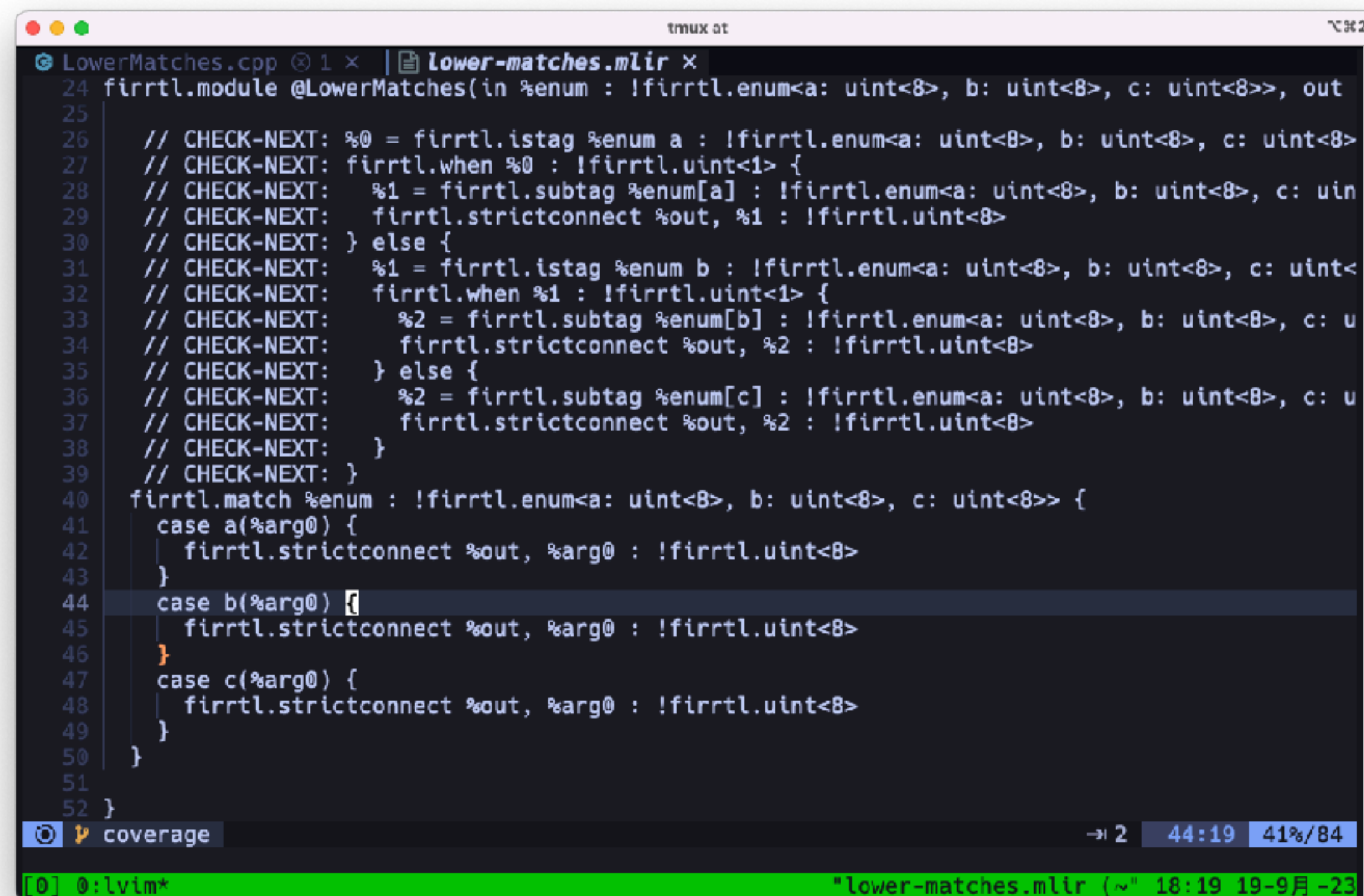
include/circt/Dialect/FIRRTL/Passes.td

@@ -257,6 +257,15 @@ def EmitOMIR : Pass<"firrtl-emitter-cmir", "firrtl::CircuitOp"> {
257 257 let dependentDialects = ["sv::SVDialect", "hw::HWDialect"];
258 258 }
259 259
260 260 + def LowerMatches : Pass<"firrtl-lower-matches", "firrtl::FModuleOp"> {
261 261 + let summary = "Remove all matches conditional blocks";
262 262 + let description = [{
263 263 + Lowers FIRRTL match statements in to when statements, which can later be

有单元测试一定先看单元测试

非常适合不熟悉代码的宝👶

- 我明白了!
- 将match语法去糖
- 当你搞明白输入输出后
 - 先大概猜一下你会怎么做
 - 实际代码可能就是这样做的
 - 如果不是，那就开眼界了

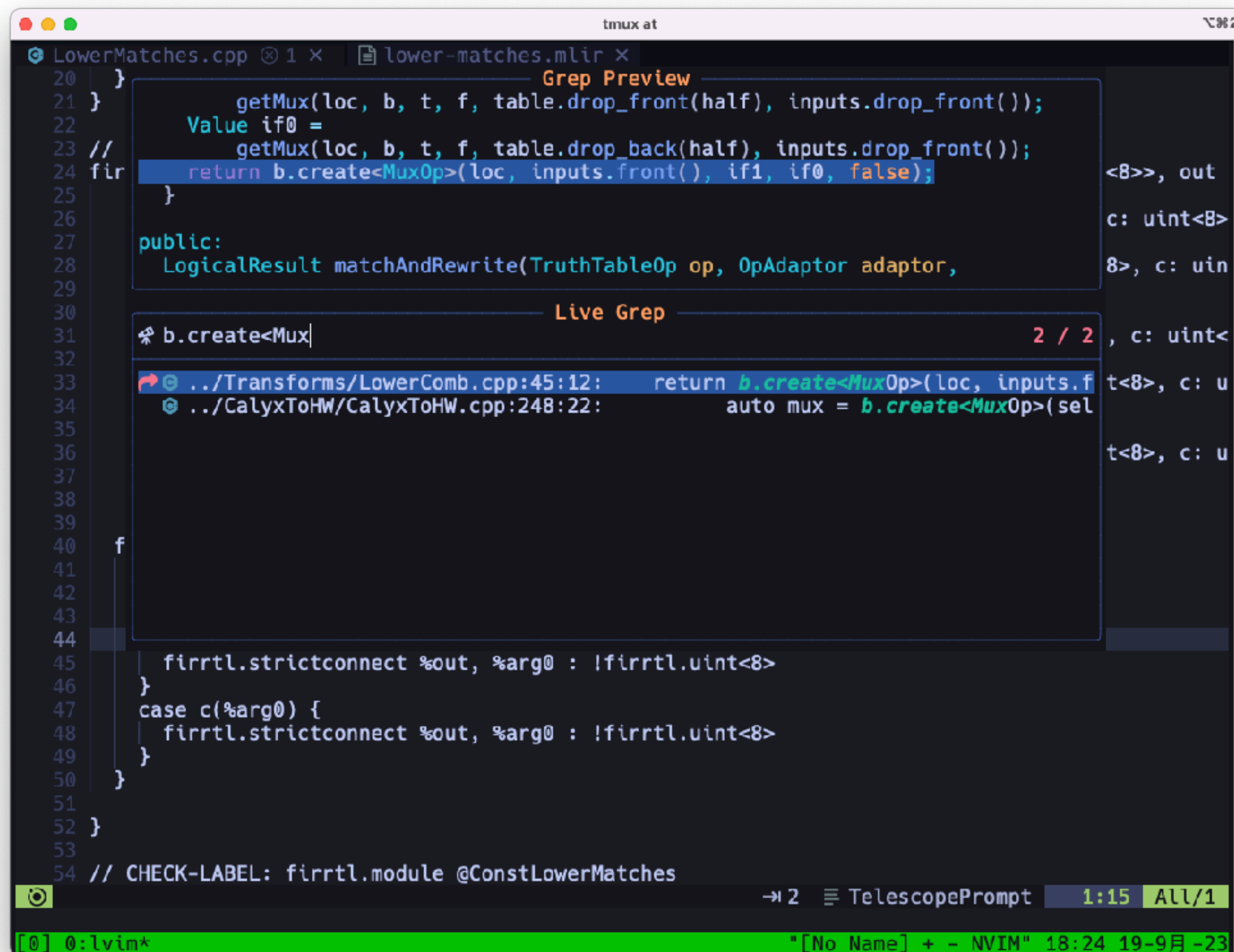


```
24 firrtl.module @LowerMatches(in %enum : !firrtl.enum<a: uint<8>, b: uint<8>, c: uint<8>>, out
25
26 // CHECK-NEXT: %0 = firrtl.istag %enum a : !firrtl.enum<a: uint<8>, b: uint<8>, c: uint<8>
27 // CHECK-NEXT: firrtl.when %0 : !firrtl.uint<1> {
28 // CHECK-NEXT:   %1 = firrtl.subtag %enum[a] : !firrtl.enum<a: uint<8>, b: uint<8>, c: uin
29 // CHECK-NEXT:   firrtl.strictconnect %out, %1 : !firrtl.uint<8>
30 // CHECK-NEXT: } else {
31 // CHECK-NEXT:   %1 = firrtl.istag %enum b : !firrtl.enum<a: uint<8>, b: uint<8>, c: uint<
32 // CHECK-NEXT:   firrtl.when %1 : !firrtl.uint<1> {
33 // CHECK-NEXT:     %2 = firrtl.subtag %enum[b] : !firrtl.enum<a: uint<8>, b: uint<8>, c: u
34 // CHECK-NEXT:     firrtl.strictconnect %out, %2 : !firrtl.uint<8>
35 // CHECK-NEXT:   } else {
36 // CHECK-NEXT:     %2 = firrtl.subtag %enum[c] : !firrtl.enum<a: uint<8>, b: uint<8>, c: u
37 // CHECK-NEXT:     firrtl.strictconnect %out, %2 : !firrtl.uint<8>
38 // CHECK-NEXT:   }
39 // CHECK-NEXT: }
40 firrtl.match %enum : !firrtl.enum<a: uint<8>, b: uint<8>, c: uint<8>> {
41   case a(%arg0) {
42     firrtl.strictconnect %out, %arg0 : !firrtl.uint<8>
43   }
44   case b(%arg0) {
45     firrtl.strictconnect %out, %arg0 : !firrtl.uint<8>
46   }
47   case c(%arg0) {
48     firrtl.strictconnect %out, %arg0 : !firrtl.uint<8>
49   }
50 }
51 }
52 }
```

案例：我不知道“😅API”怎么用

有问🤖的功夫，我都搜到例子了

- 前提你得知道这个API的样子
 - 比如: `b.create<MuxOp>(😅);`
 - 问题: 😅 = ?
- 然后试着搜索一下
 - 80%的问题很快解决



The screenshot shows a code editor window titled "tmux at" with a file named "LowerMatches.cpp". The editor displays a C++ function `fir` that uses `b.create<MuxOp>`. A search bar at the top right shows the query `b.create<MuxOp>` with 2 results. The search results list two occurrences: one in `../Transforms/LowerComb.cpp:45:12` and another in `../CalyxToHW/CalyxToHW.cpp:248:22`. The editor also shows a "Grep Preview" window with the following code snippet:

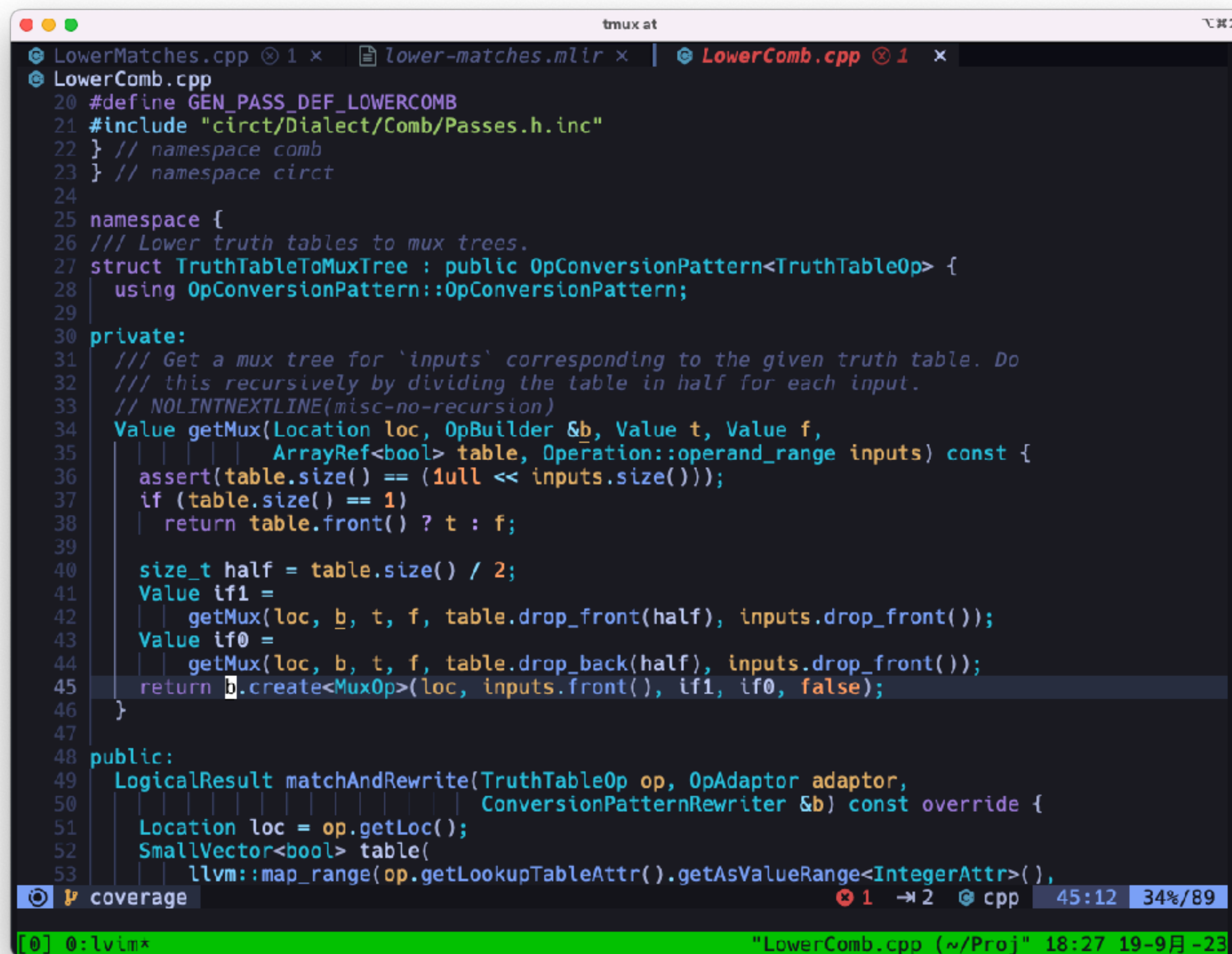
```
getMux(loc, b, t, f, table.drop_front(half), inputs.drop_front());
Value if0 =
getMux(loc, b, t, f, table.drop_back(half), inputs.drop_front());
return b.create<MuxOp>(loc, inputs.front(), if1, if0, false);
```

The editor interface includes a status bar at the bottom showing the current file path, line number, and column number.

案例：我不知道“😅API”怎么用

有问🤖的功夫，我都搜到例子了

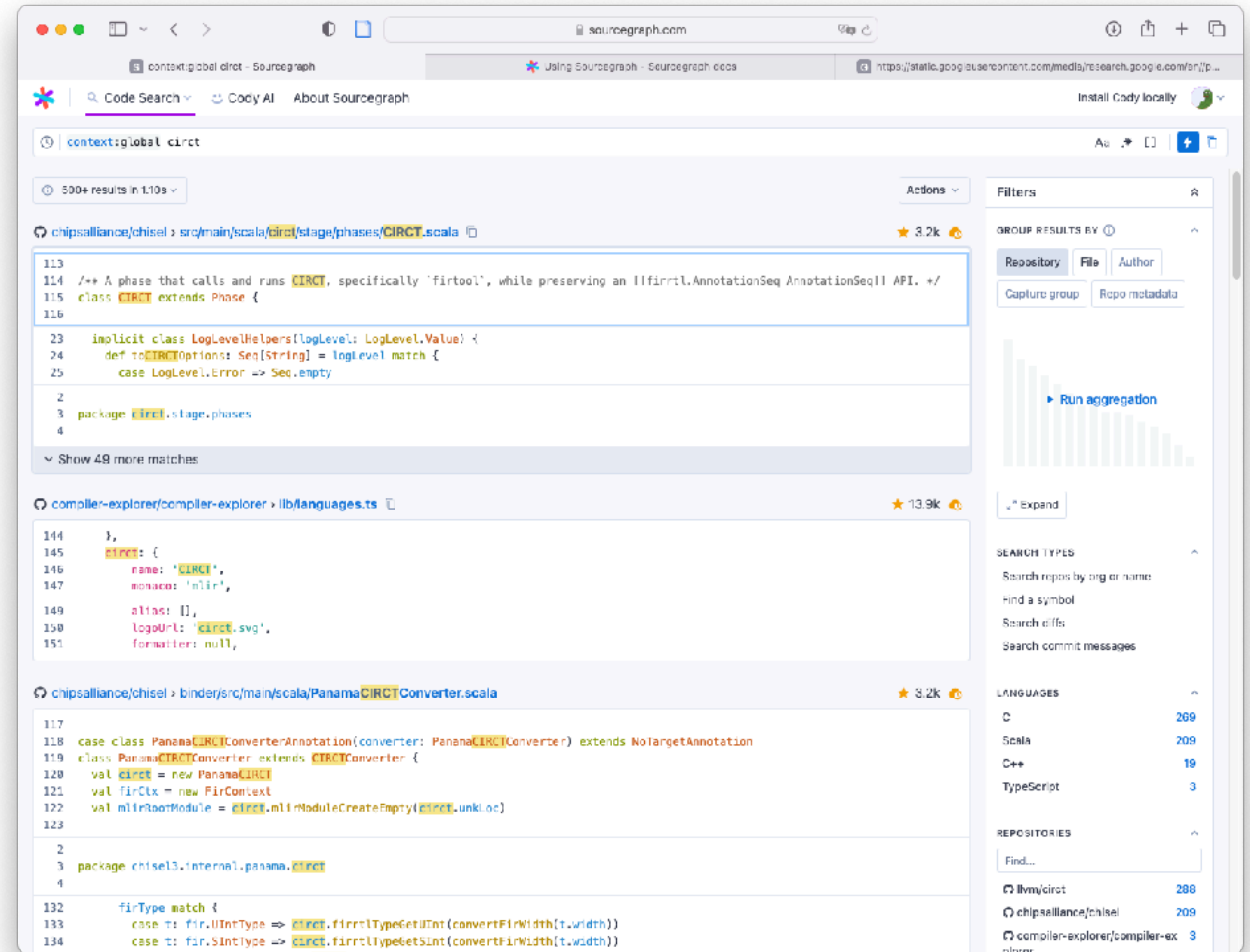
- 前提你得知道这个API的样子
 - 比如: `b.create<MuxOp>(😅);`
 - 问题: 😅 = ?
- 然后试着搜索一下
 - 80%的问题很快解决



```
tmux at
LowerMatches.cpp 1 x | lower-matches.mlir x | LowerComb.cpp 1 x
LowerComb.cpp
20 #define GEN_PASS_DEF_LOWERCOMB
21 #include "circt/Dialect/Comb/Passes.h.inc"
22 } // namespace comb
23 } // namespace circt
24
25 namespace {
26 /// Lower truth tables to mux trees.
27 struct TruthTableToMuxTree : public OpConversionPattern<TruthTableOp> {
28   using OpConversionPattern::OpConversionPattern;
29 private:
30   /// Get a mux tree for 'inputs' corresponding to the given truth table. Do
31   /// this recursively by dividing the table in half for each input.
32   // NOLINTNEXTLINE(misc-no-recursion)
33   Value getMux(Location loc, OpBuilder &b, Value t, Value f,
34               ArrayRef<bool> table, Operation::operand_range inputs) const {
35     assert(table.size() == (1ull << inputs.size()));
36     if (table.size() == 1)
37       return table.front() ? t : f;
38     size_t half = table.size() / 2;
39     Value if1 =
40       getMux(loc, b, t, f, table.drop_front(half), inputs.drop_front());
41     Value if0 =
42       getMux(loc, b, t, f, table.drop_back(half), inputs.drop_front());
43     return b.create<MuxOp>(loc, inputs.front(), if1, if0, false);
44   }
45 public:
46   LogicalResult matchAndRewrite(TruthTableOp op, OpAdaptor adaptor,
47                               ConversionPatternRewriter &b) const override {
48     Location loc = op.getLoc();
49     SmallVector<bool> table(
50       llvm::map_range(op.getLookupTableAttr().getAsValueRange<IntegerAttr>(),
51                       ...
52
coverage 1 → 2 cpp 45:12 34%/89
[0] 0:lvim* "LowerComb.cpp (~/Proj" 18:27 19-9月-23
```

读代码更方便 安利时间

- SourceGraph (sourcegraph.com)
- 该产品源自Google的一项研究^[1]
 - 98%的开发者认为他们需要一个便捷的代码搜索工具
 - 开发者每天平均与工具交互5.3个会话
- SourceGraph能够帮助你
 - 找到示例代码
 - 阅读/评审代码
 - 调试代码
 - 定位特定代码
 - 分析更改带来的影响



[1]: Google: “How Developers Search for Code: A Case Study”

最难忘的夏天

- 在开源之夏与Buddy Compiler社区相识
 - 感谢洪滨学长、柳彤学长的指导
 - 感受社区的氛围
 - 实现了比OpenCV更快的计算优化
- 现在把开源之夏分享给大家

总结

- 如何读代码？
 - 先在开源之夏领个任务
 - 从单元测试入手清楚输入输出
 - 从代码库找到样例代码
- 相信自己
 - 做别人没做过的事
 - 让我们一起努力，成为Code Hero^{*}

^{*} 现在LLMs还有上下文长度限制，是干翻他们的好时候。