



## Why add an IR reader to IIvm-debuginfo-analyzer tool

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Reduce the noisiness of comparing the debuginfo in LLVM IR

## Reduce the noisiness of comparing the debuginfo in LLVM IR





```
simplify-cfq.ll
                                                                                         slp-vectorizer.ll
134 = distinct IDILexicalBlock(scope: 126, file: 11,
                                                               134 = distinct IDILexicalBlock(scope: 126, file: 11,
line: 22, column: 6)
                                                               line: 22, column: 6)
                                                               !35 = !DILocalVariable(name: "x1", scope: !26, file: !1,
135 = !DILocation(line: 23, column: 26, scope: !34)
                                                               line: 20, type: 14)
!36 = !DILocalVariable (name: "x1", scope: !26, file: !1,
                                                               !36 = !DILocation(line: 24, column: 16, scope: !34)
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145 = distinct [{145, 132, 146, 147}
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146 = IDILocation(line: 26, column: 20, scope: 126)
                                                               146 = [(["llvm.loop.mustprogress")
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148 = IDILocation(line: 28, column: 20, scope: 126)
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                                                               152 = IDILocation(line: 28, column: 7, scope: 126)
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155 = IDILocation(line: 29, column: 11, scope: 126)
                                                               155 = IDILocation(line: 31, column: 1, scope: 126)
156 = !DILocation(line: 30, column: 16, scope: !26)
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Ln: 105 Col: 1/52 Ch: 1/52 EOL: CRLF
                                          Windows-1252
                                                               Line: 131-132
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  136 = IDILocation (line: 24, column: 16, scope: 134)
```

```
Reference: 'simplify-cfg.11'
           'slp-vectorizer.11'
Target:
(2) Missing Symbols:
     20
            {Variable} 'x1' -> 'float'
            {Variable} 'x2' -> 'float'
(5) Missing Lines:
     24
            {Line}
            {Line}
            {Line}
     30
            {Line}
            {Line}
Reference: 'simplify-cfg.ll'
           'slp-vectorizer.11'
Target:
Logical View:
            {File} 'simplify-cfg.ll'
              {CompileUnit} 'test.cpp'
                {Function} extern not inlined 'RandF32' -> 'float'
                  {Variable} 'uRand' -> 'U32'
                  {Variable} 'fRand' -> 'F32'
                {Function} extern not inlined 'randGauss' -> 'void'
                  {Parameter} 'work' -> '* float'
     20
                  {Variable} 'w' -> 'float'
                  {Variable} 'x1' -> 'float'
                  {Variable} 'x2' -> 'float'
```

IR changes: comparison tool

IR changes: Ilvm-debuginfo-analyzer

## Why add an IR reader to Ilvm-debuginfo-analyzer tool





#### LLVM and debug information

- Different formats, toolchain, tools
- Common problems

#### Analyzing optimizer IR output

- IR before/after an optimizer pass
- Test case: SLP Vectorizer pass drops debug information

#### Ilvm-debuginfo-analyzer

- Basic introduction
- Print logical view
- Compare logical view

## **LLVM** and debug information - inputs





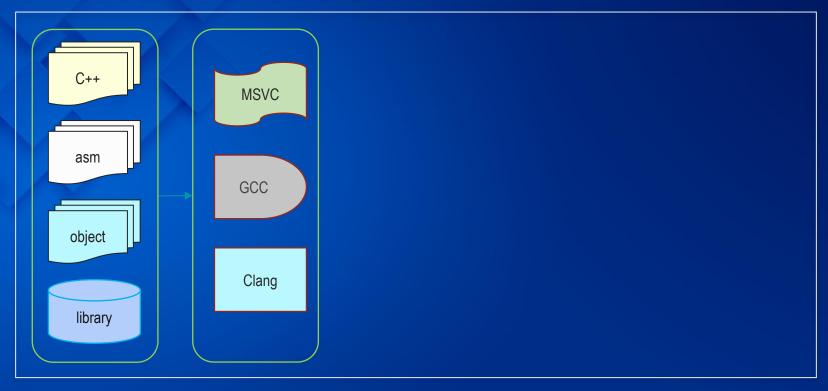


Different inputs

## **LLVM and debug information - toolchains**





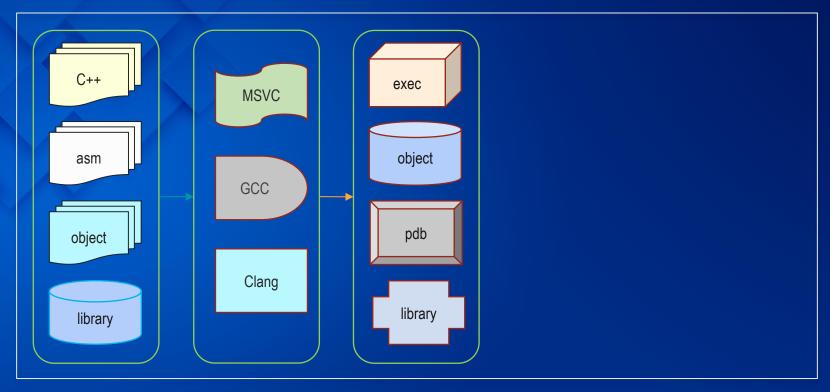


Different toolchains

## **LLVM** and debug information - binary file formats





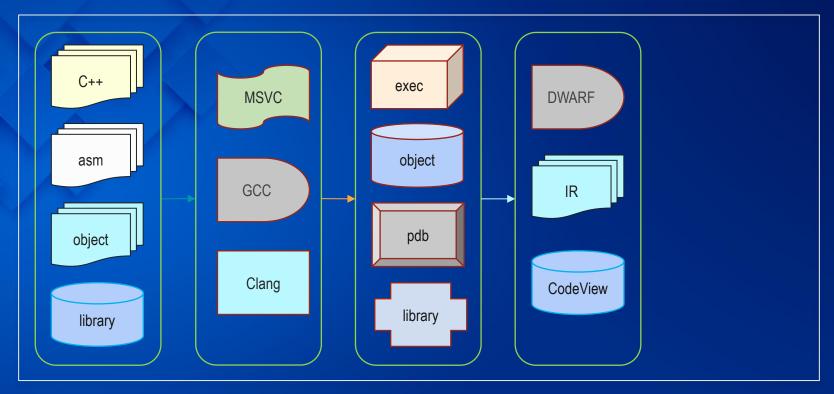


Different binary formats

## **LLVM** and debug information - debug information formats





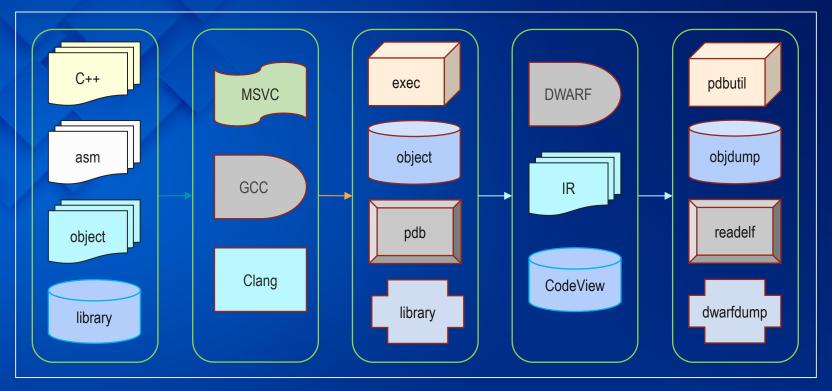


Different debug information formats

## LLVM and debug information - debug information tools







Different debug information tools

## **Common problems with debug information**





Does the debug information represent the original source

- Which variables are dropped due to optimization
- Why I cannot stop at a particular line
- Which lines are associated to a specific code range
- Size changes due to toolchain features

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Semantic differences in the generated debug information

- By different toolchain versions (same platform)
- Same source code compiled in different platforms

## **Analyzing optimizer IR output**





#### IR before/after an optimizer pass

The IR output is very rich and noisy

- The metadata identifiers changes between passes
- Difficult to see the changes using a comparison tool
- Requires knowledge about the IR and passes
- By bisection, we can pin down which pass causes the change

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The optimizer includes a wide set of debug printing options

--print-before, --print-before-all, --print-after, --print-after-all, etc.

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Test case: SLP Vectorizer pass drops debug information

- [DebugInfo@O2] https://github.com/llvm/llvm-project/issues/45507
- Drops location information for local variables x1 and x2
- Generate IR after Simplify CFG and SLP Vectorizer passes

#### IR metadata - Simplify CFG and SLP Vectorizer passes





```
1 // Compile with clang -g -02.
2 // The SLP Vectorizer pass drops location
3 // information for the local variables:
4 // x1 and x2.
6 typedef unsigned int U32;
7 typedef float F32;
8 extern "C" double log(float);
9 extern "C" double sqrt(float);
10
11 extern unsigned RandU32();
13 float RandF32() {
14 U32 uRand = RandU32();
15 F32 fRand = ((F32)uRand / 4294967810.0f);
16 return (fRand);
17 }
18
19 void randGauss(float work[2]) {
    float x1, x2, w;
22 do {
    x1 = 2.f * RandF32() - 1.f;
    x2 = 2.f * RandF32() - 1.f;
24
      w = x1 * x1 + x2 * x2;
26
    } while (w >= 1.f);
    w = sqrt((-2.f * log(w)) / w);
    work[0] = x1 * w;
    work[1] = x2 * w;
31 }
```

#### IR metadata - Simplify CFG and SLP Vectorizer passes





```
1 // Compile with clang -g -O2.
 2 // The SLP Vectorizer pass drops location
 3 // information for the local variables:
 4 // x1 and x2.
 6 typedef unsigned int U32;
 7 typedef float F32;
 8 extern "C" double log(float);
9 extern "C" double sqrt(float);
10
11 extern unsigned RandU32();
13 float RandF32() {
14     U32 uRand = RandU32();
15 F32 fRand = ((F32)uRand / 4294967810.0f);
16 return (fRand);
17 }
18
19 void randGauss(float work[2]) {
     float x1, x2, w;
22
    do {
      x1 = 2.f * RandF32() - 1.f:
24
      x2 = 2.f * RandF32() - 1.f;
25
       w = x1 * x1 + x2 * x2;
26
     } while (w >= 1.f);
28
    w = \operatorname{sqrt}((-2.f * \log(w)) / w);
29
    work[0] = x1 * w;
    work[1] = x2 * w;
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```

```
!35 = !DILocation(line: 23, column: 26, scope: !34)
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```

IR metadata after Simplify CFG

## IR metadata - Simplify CFG and SLP Vectorizer passes





```
1 // Compile with clang -g -O2.
 2 // The SLP Vectorizer pass drops location
 3 // information for the local variables:
 4 // x1 and x2.
 6 typedef unsigned int U32;
 7 typedef float F32;
8 extern "C" double log(float);
9 extern "C" double sart(float):
10
11 extern unsigned RandU32();
13 float RandF32() {
15 F32 fRand = ((F32)uRand / 4294967810.0f);
16 return (fRand);
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18
19 void randGauss(float work[2]) {
     float x1, x2, w;
    do {
      x1 = 2.f * RandF32() - 1.f:
      x2 = 2.f * RandF32() - 1.f;
      w = x1 * x1 + x2 * x2;
26
    } while (w >= 1.f);
    w = sqrt((-2.f * log(w)) / w);
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    work[0] = x1 * w;
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IR metadata after Simplify CFG

IR metadata after SLP Vectorizer

#### IR metadata comparison - comparison tool





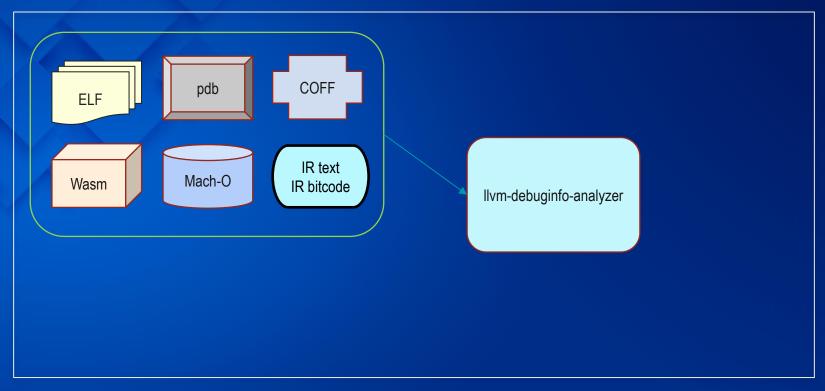
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                                                               134 = distinct IDILexicalBlock(scope: 126, file: 11,
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IR changes: comparison tool

## **Ilvm-debuginfo-analyzer - binary file formats**





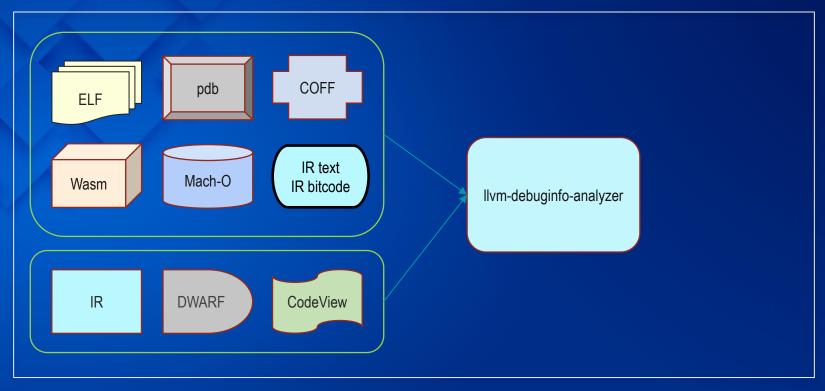


Supported binary file formats

## **Ilvm-debuginfo-analyzer - debug information formats**





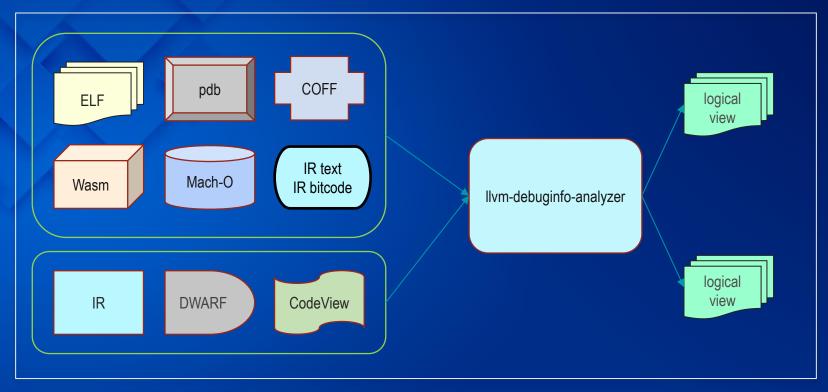


Supported debug information formats

## Ilvm-debuginfo-analyzer - canonical logical views





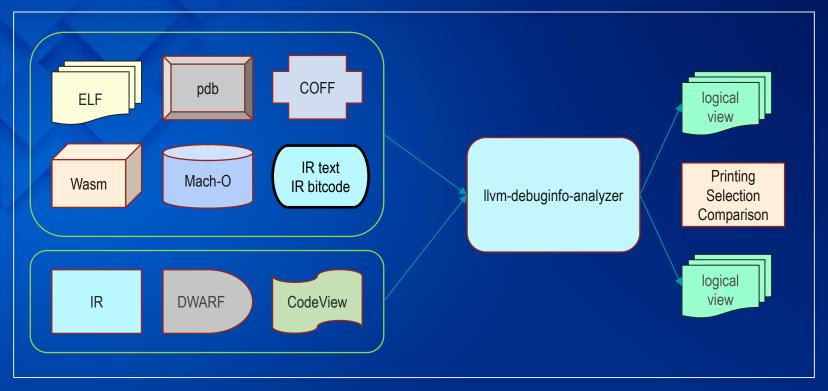


Logical view is a high-level representation of the debug information

## Ilvm-debuginfo-analyzer - printing, selection, comparison







Logical views can be printed, selected and compared

#### **DWARF** debug information (IIvm-dwarfdump)





```
DW_TAG_compile_unit
  DW_AT_producer ("clang")
  DW AT language
                  (DW LANG C plus plus 14)
  DW AT name
                  ("hello-world.cpp")
  DW AT low pc
                  (0x00000000000000000)
  DW_AT_high_pc
                  (0x0000000000000014)
  DW_AT_addr_base (0x00000008)
  DW TAG variable
   DW_AT_type
                   (0x0000002d "const char[13]")
   DW_AT_decl_line (4)
   DW_AT_location (DW_OP_addrx 0x0)
  DW_TAG_array_type
   DW AT type
                  (0x00000039 "const char")
   DW_TAG_subrange_type
     DW AT type (0x00000042 " ARRAY SIZE TYPE ")
     DW AT count (0x0d)
  DW TAG subprogram
   DW_AT_low_pc
                        (0x0000000000000000)
   DW AT high pc
                        (0x00000000000000014)
   DW AT frame base
                       (DW_OP_reg6 RBP)
   DW AT linkage name (" Z3foov")
   DW AT name
                       ("foo")
   DW AT decl line
   DW AT external
                        (true)
```

DWARF debug information

#### **CodeView debug information (Ilvm-pdbutil)**





```
DW TAG compile unit
 DW_AT_producer ("clang")
 DW AT language
                  (DW LANG C plus plus 14)
 DW AT name
                  ("hello-world.cpp")
 DW AT low pc
                  (0x00000000000000000)
 DW AT high pc
                  (0x0000000000000014)
 DW_AT_addr_base (0x00000008)
  DW TAG variable
                    (0x0000002d "const char[13]")
   DW AT type
   DW AT_decl_line (4)
   DW_AT_location (DW_OP_addrx 0x0)
  DW TAG array type
   DW_AT_type
                  (0x00000039 "const char")
    DW TAG subrange type
     DW AT type (0x00000042 " ARRAY SIZE TYPE ")
     DW AT count (0x0d)
  DW TAG subprogram
   DW AT low pc
                        (0x0000000000000000)
   DW AT high pc
                        (0x0000000000000014)
   DW AT frame base
                       (DW OP reg6 RBP)
   DW_AT_linkage_name ("_Z3foov")
    DW AT name
                        ("foo")
   DW AT decl line
    DW AT external
                        (true)
```

DWARF debug information

```
Types (.debug$T)
 _____
0x1000 | LF ARGLIST [size = 8]
0x1001 | LF PROCEDURE [size = 16]
                           return type = 0x0003 (void), # args = 0,
param list = 0 \times 1000
                            calling conv = cdecl, options = None
0x1002 | LF FUNC ID [size = 16]
                           name = foo, type = 0x1001, parent scope =
<no type>
0x1004 | LF STRING ID [size = 24] ID: <no type>,
String: hello-world.cpp
Symbols
Mod 0000 \ \daggerightarrow\daggerightarrow\daggerightarrow\daggerightarrow\daggerightarrow\daggerightarrow\daggerightarrow\daggerightarrow\daggerightarrow\daggerightarrow\daggerightarrow\daggerightarrow\daggerightarrow\daggerightarrow\daggerightarrow\daggerightarrow\daggerightarrow\daggerightarrow\daggerightarrow\daggerightarrow\daggerightarrow\daggerightarrow\daggerightarrow\daggerightarrow\daggerightarrow\daggerightarrow\daggerightarrow\daggerightarrow\daggerightarrow\daggerightarrow\daggerightarrow\daggerightarrow\daggerightarrow\daggerightarrow\daggerightarrow\daggerightarrow\daggerightarrow\daggerightarrow\daggerightarrow\daggerightarrow\daggerightarrow\daggerightarrow\daggerightarrow\daggerightarrow\daggerightarrow\daggerightarrow\daggerightarrow\daggerightarrow\daggerightarrow\daggerightarrow\daggerightarrow\daggerightarrow\daggerightarrow\daggerightarrow\daggerightarrow\daggerightarrow\daggerightarrow\daggerightarrow\daggerightarrow\daggerightarrow\daggerightarrow\daggerightarrow\daggerightarrow\daggerightarrow\daggerightarrow\daggerightarrow\daggerightarrow\daggerightarrow\daggerightarrow\daggerightarrow\daggerightarrow\daggerightarrow\daggerightarrow\daggerightarrow\daggerightarrow\daggerightarrow\daggerightarrow\daggerightarrow\daggerightarrow\daggerightarrow\daggerightarrow\daggerightarrow\daggerightarrow\daggerightarrow\daggerightarrow\daggerightarrow\daggerightarrow\daggerightarrow\daggerightarrow\daggerightarrow\daggerightarrow\daggerightarrow\daggerightarrow\daggerightarrow\daggerightarrow\daggerightarrow\daggerightarrow\daggerightarrow\daggerightarrow\daggerightarrow\daggerightarrow\daggerightarrow\daggerightarrow\daggerightarrow\daggerightarrow\daggerightarrow\daggerightarrow\daggerightarrow\daggerightarrow\daggerightarrow\daggerightarrow\daggerightarrow\daggerightarrow\daggerightarrow\daggerightarrow\daggerightarrow\daggerightarrow\daggerightarrow\daggerightarrow\daggerightarrow\daggerightarrow\daggerightarrow\daggerightarrow\daggerightarrow\daggerightarrow\daggerightarrow\daggerightarrow\da
                     0 | S OBJNAME [size = 64] sig=0. `hello-
world-clang-cv.o`
                    0 | S COMPILE3 [size = 156]
                                  machine = intel x86-x64, Ver = clang
version 21.0.0, language = c++
                                  frontend = 21.0.0.0 flags = none
                     0 | S GPROC32 ID [size = 44] `foo`
                                  parent = 0, end = 0, addr = 0000:0000
                                 type = 0x1002 (foo), debug start = 0,
debug end = 0, flags = noinline | opt debuginfo
                    0 | S FRAMEPROC [size = 32]
                                  size = 40, padding size = 0 padding = 0
                                  bytes of callee saved registers = 0,
exception handler addr = 0000:0000
                                  local fp reg = RSP, param fp reg = RSP
                                  flags = safe buffers
                     0 | S PROC ID END [size = 4]
                     0 | S BUILDINFO [size = 8] BuildId = `0x1008`
```

CodeView debug information

#### **DWARF & CodeView canonical logical view**





```
DW TAG compile unit
  DW AT producer ("clang")
                   (DW LANG C plus plus 14)
  DW AT language
  DW AT name
                   ("hello-world.cpp")
                   (0x00000000000000000)
  DW AT low pc
  DW AT high pc
                  (0x0000000000000014)
  DW_AT_addr_base (0x00000008)
  DW TAG variable
    DW AT type
                    (0x0000002d "const char[13]")
   DW AT_decl_line (4)
   DW_AT_location (DW_OP_addrx 0x0)
  DW TAG array type
                   (0x00000039 "const char")
    DW AT type
    DW TAG subrange type
     DW AT type (0x00000042 " ARRAY SIZE TYPE ")
      DW AT count (0x0d)
  DW TAG subprogram
    DW AT low pc
                        (0x0000000000000000)
                        (0x00000000000000014)
    DW AT high pc
    DW AT frame base
                        (DW OP reg6 RBP)
    DW_AT_linkage_name ("_Z3foov")
    DW AT name
                        ("foo")
    DW AT decl line
                        (3)
    DW AT external
                        (true)
```

```
Logical View:
   {File} 'hello-world-clang.o'
      {CompileUnit} 'hello-world.cpp'
        {Array} 'const char [13]'
        {Function} not inlined 'foo' -> 'void'
          {Line}
          {Code} 'pushq
                                      %rbp'
          {Code} 'mova
                                      %rsp, %rbp'
          {Line}
          {Code} 'lead
                                      (%rip), %rdi'
          {Code}
                 'movb
                                      $0x0, %al'
          {Code} 'callq
                                      0x0'
          {Line}
                                      %rbp'
          {Code}
                 'popq
          {Code} 'retq'
          {Line}
        {Variable} '' -> 'const char [13]'
```

```
Types (.debug$T)
 _____
0x1000 | LF ARGLIST [size = 8]
0x1001 | LF PROCEDURE [size = 16]
                           return type = 0x0003 (void), # args = 0,
param list = 0 \times 1000
                            calling conv = cdecl, options = None
0x1002 | LF FUNC ID [size = 16]
                           name = foo, type = 0x1001, parent scope =
 <no type>
0x1004 | LF STRING ID [size = 24] ID: <no type>,
String: hello-world.cpp
Symbols
Mod 0000 \ \daggerightarrow\daggerightarrow\daggerightarrow\daggerightarrow\daggerightarrow\daggerightarrow\daggerightarrow\daggerightarrow\daggerightarrow\daggerightarrow\daggerightarrow\daggerightarrow\daggerightarrow\daggerightarrow\daggerightarrow\daggerightarrow\daggerightarrow\daggerightarrow\daggerightarrow\daggerightarrow\daggerightarrow\daggerightarrow\daggerightarrow\daggerightarrow\daggerightarrow\daggerightarrow\daggerightarrow\daggerightarrow\daggerightarrow\daggerightarrow\daggerightarrow\daggerightarrow\daggerightarrow\daggerightarrow\daggerightarrow\daggerightarrow\daggerightarrow\daggerightarrow\daggerightarrow\daggerightarrow\daggerightarrow\daggerightarrow\daggerightarrow\daggerightarrow\daggerightarrow\daggerightarrow\daggerightarrow\daggerightarrow\daggerightarrow\daggerightarrow\daggerightarrow\daggerightarrow\daggerightarrow\daggerightarrow\daggerightarrow\daggerightarrow\daggerightarrow\daggerightarrow\daggerightarrow\daggerightarrow\daggerightarrow\daggerightarrow\daggerightarrow\daggerightarrow\daggerightarrow\daggerightarrow\daggerightarrow\daggerightarrow\daggerightarrow\daggerightarrow\daggerightarrow\daggerightarrow\daggerightarrow\daggerightarrow\daggerightarrow\daggerightarrow\daggerightarrow\daggerightarrow\daggerightarrow\daggerightarrow\daggerightarrow\daggerightarrow\daggerightarrow\daggerightarrow\daggerightarrow\daggerightarrow\daggerightarrow\daggerightarrow\daggerightarrow\daggerightarrow\daggerightarrow\daggerightarrow\daggerightarrow\daggerightarrow\daggerightarrow\daggerightarrow\daggerightarrow\daggerightarrow\daggerightarrow\daggerightarrow\daggerightarrow\daggerightarrow\daggerightarrow\daggerightarrow\daggerightarrow\daggerightarrow\daggerightarrow\daggerightarrow\daggerightarrow\daggerightarrow\daggerightarrow\daggerightarrow\daggerightarrow\daggerightarrow\daggerightarrow\daggerightarrow\daggerightarrow\daggerightarrow\daggerightarrow\daggerightarrow\daggerightarrow\daggerightarrow\daggerightarrow\daggerightarrow\daggerightarrow\daggerightarrow\daggerightarrow\da
                     0 | S OBJNAME [size = 64] sig=0, `hello-
world-clang-cv.o`
                     0 | S COMPILE3 [size = 156]
                                  machine = intel x86-x64, Ver = clang
version 21.0.0, language = c++
                                  frontend = 21.0.0.0 flags = none
                     0 | S GPROC32 ID [size = 44] `foo`
                                  parent = 0, end = 0, addr = 0000:0000
                                  type = 0x1002 (foo), debug start = 0,
debug end = 0, flags = noinline | opt debuginfo
                    0 | S FRAMEPROC [size = 32]
                                  size = 40, padding size = 0 padding = 0
                                  bytes of callee saved registers = 0,
exception handler addr = 0000:0000
                                  local fp reg = RSP, param fp reg = RSP
                                  flags = safe buffers
                     0 | S PROC ID END [size = 4]
                     0 | S BUILDINFO [size = 8] BuildId = `0x1008`
```

CodeView debug information

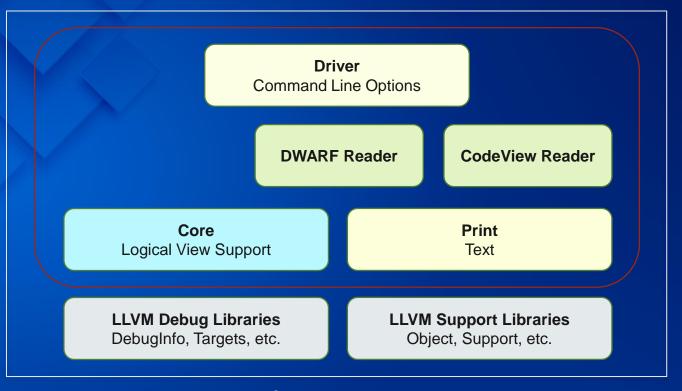
Canonical logical view

DWARF debug information

## Ilvm-debuginfo-analyzer - current components





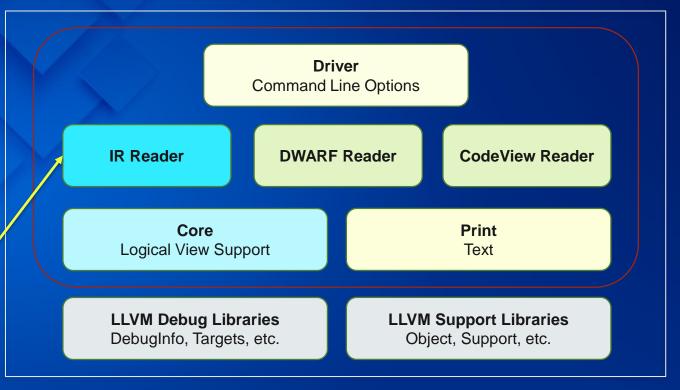


Current components

## Ilvm-debuginfo-analyzer - IR reader component







IR Reader component

## **Print logical views**





Common options to print logical views when dealing with IR

- --attribute=level
- --print=scopes,types,symbols,lines

## **Print logical views**





Common options to print logical views when dealing with IR

- --attribute=level
- --print=scopes,types,symbols,lines

#### IR tests

- After Simplify CFG pass: simplify-cfg.ll
- After SLP Vectorizer pass: slp-vectorizer.ll

## **Print logical views**





#### Common options to print logical views when dealing with IR

- --attribute=level
- --print=scopes,types,symbols,lines

#### IR tests

- After Simplify CFG pass: simplify-cfg.ll
- After SLP Vectorizer pass: slp-vectorizer.ll

#### Ilvm-debuginfo-analyzer command line

- --attribute=level --print=scopes,symbols,types simplify-cfg.ll
- --attribute=level --print=scopes,symbols,types slp-vectorizer.ll

## Logical views for Simplify CFG and SLP Vectorizer passes





```
!llvm.module.flags = !{!5, !6, !7, !8, !9, !10, !11}
10 = distinct !DICompileUnit(language: DW_LANG_C_plus_plus_14, file: !1, producer: "clang", isOptimized: false, runtimeVersion: 0,
emissionKind: FullDebug, retainedTypes: !2, splitDebugInlining: false, nameTableKind: None),
!1 = !DIFile(filename: "test.cop", directory: "
.13 = !DIDerivedType(tag: DW_TAG_typedef, name: "F32", file: !1, line: 7, baseType: !4)
!4 = !DIBasicType(name: "float", size: 32, encoding: DW_ATE_float)
15 = 1(i32 7 1*Dwarf Version* i32 5)
113 = distinct DISubprogram(name: "RandF32", linkageName: "Z7RandF32v", scope: 11, file: 11, line: 13, type: 114, scopeLine: 13, flags:
DIFlagPrototyped, spFlags: DISPFlagDefinition, unit: 10, retainedNodes: 116)
!14 = !DISubroutineType(types: !15)
!17 = !DILocation(line: 14, column: 15, scope: !13)
!18 = !DILocalVariable(name: "uRand", scope: !13, file: !1, line: 14, type: !19)
!19 = !DIDerivedType(tag: DW_TAG_typedef, name: "U32", file: !1, line: 6, baseType: !20)
!20 = !DIBasicType(name: "unsigned int", size: 32, encoding: DW_ATE_unsigned)
!21 = !DILocation(line: 0, scope: !13)
!23 = !DILocation(line: 15, column: 27, scope: !13)
!24 = !DILocalVariable(name: "fRand", scope: !13, file: !1, line: 15, type: !3)
!25 = !DILocation(line: 16, column: 3, scope: !13)
!26 = distinct!DISubprogram(name: "randGauss", linkageName: " Z9randGaussPl", scope: !1, file: !1, line: 19, type: !27, scopeLine: 19,
flags: DIFlagPrototyped, spFlags: DISPFlagDefinition, unit: !0, retainedNodes: !16)
!27 = !DISubroutineType(types: !28)
!28 = !{null, !29}
!29 = !DIDerivedType(tag: DW_TAG_pointer_type, baseType: !4, size: 64)
!30 = !DILocalVariable(name: "work", arg: 1, scope: !26, file: !1, line: 19, type: !29)
!31 = !DILocation(line: 0, scope: !26)
!32 = !DILocation(line: 22, column: 3, scope: !26)
!33 = !DILocation(line: 23, column: 16, scope: !34)
!34 = distinct !DILexicalBlock(scope: !26, file: !1, line: 22, column: 6)
135 = IDILocation(line: 23, column: 26, scope: !34)
!36 = !DILocalVariable(name: "x1", scope: !26, file: !1, line: 20, type: !4)
!37 = !DILocation(line: 24, column: 16, scope: !34]
!38 = !DILocation(line: 24, column: 26, scope: !34)
!39 = !DILocalVariable(name: "x2", scope: !26, file: !1, line: 20, type: !4)
!40 = !DILocation(line: 25, column: 22, scope: !34)
!41 = !DILocation(line: 25, column: 17, scope: !34)
!42 = !DILocalVariable(name: "w", scope: !26, file: !1, line: 20, type: !4)
!44 = !DILocation(line: 26, column: 3, scope: !34)
!45 = distinct !{!45, !32, !46, !47}
!46 = !DILocation(line: 26, column: 20, scope: !26)
!49 = !DILocation(line: 28, column: 18, scope: !26)
!50 = !DILocation(line: 28, column: 30, scope: !26)
!51 = !DILocation(line: 28, column: 28, scope: !26)
!52 = !DILocation(line: 28, column: 12, scope: !26)
153 = IDII ocation(line: 28, column: 7, scope: 126)
!54 = !DILocation(line: 29, column: 16, scope: !26)
!55 = !DILocation(line: 29, column: 11, scope: !26)
!56 = !DILocation(line: 30, column: 16, scope: !26)
!57 = !DILocation(line: 30, column: 3, scope: !26)
!58 = !DILocation(line: 30, column: 11, scope: !26)
```

IR metadata after Simplify CFG

!59 = !DILocation(line: 31, column: 1, scope: !26)

#### Logical views for Simplify CFG and SLP Vectorizer passes





```
!llvm.dba.cu = !(!0)
!llvm.module.flags = !{!5, !6, !7, !8, !9, !10, !11}
10 = distinct !DICompileUnit(language: DW_LANG_C_plus_plus_14, file: !1, producer: "clang", isOptimized: false, runtimeVersion: 0,
emissionKind: FullDebug, retainedTypes: !2, splitDebugInlining: false, nameTableKind: None)
!1 = !DIFile(filename: "test.coo", directory: "
!3 = !DIDerivedType(tag: DW_TAG_typedef, name: "F32", file: !1, line: 7, baseType: !4)
!4 = !DIBasicType(name: "float", size: 32, encoding: DW_ATE_float)
15 = 1(i32 7 1"Dwarf Version" i32 5)
!6 = !(i32 2, !"Debug Info Version", i32 3)
!12 = !{!"clang"}
113 = distinct IDISubprogram(name: "RandF32", linkageName: ", Z7RandF32v", scope: 11, file: 11, line: 13, type: 114, scopeLine: 13, flags
DIFlagPrototyped, spFlags: DISPFlagDefinition, unit: 10, retainedNodes: 116)
!14 = !DISubroutineType(types: !15)
!17 = !DILocation(line: 14, column: 15, scope: !13)
!18 = !DILocalVariable(name: "uRand", scope: !13, file: !1, line: 14, type: !19)
!19 = !DIDerivedType(tag: DW_TAG_typedef, name: "U32", file: !1, line: 6, baseType: !20)
!20 = !DIBasicType(name: "unsigned int", size: 32, encoding: DW_ATE_unsigned)
!21 = !DILocation(line: 0, scope: !13)
122 = IDILocation(line: 15, column: 21, scope: !13)
!23 = !DILocation(line: 15, column: 27, scope: !13)
!24 = !DILocalVariable(name: "fRand", scope: !13, file: !1, line: 15, type: !3)
!25 = !DILocation(line: 16, column: 3, scope: !13)
 126 = distinct !DISubprogram(name: "randGauss", linkageName: ". Z9randGaussPf", scope; !1, file: !1, line: 19, type: !27, scopeLine: 19,
flags: DIFlagPrototyped, spFlags: DISPFlagDefinition, unit: !0, retainedNodes: !16)
!27 = !DISubroutineType(types: !28)
128 = !{null 129}
!29 = !DIDerivedType(tag: DW_TAG_pointer_type, baseType: !4, size: 64)
!30 = !DILocalVariable(name: "work", arg: 1, scope: !26, file: !1, line: 19, type: !29)
!31 = !DILocation(line: 0, scope: !26)
!32 = !DILocation(line: 22, column: 3, scope: !26)
133 = IDH ocation/line: 23, column: 16, scope: 1341
!34 = distinct !DILexicalBlock(scope: !26, file: !1, line: 22, column: 6)
!35 = !DILocation(line: 23, column: 26, scope: !34)
!36 = !DILocalVariable(name: "x1", scope: !26, file: !1, line: 20, type: !4)
!37 = !DILocation(line: 24, column: 16, scope: !34]
!38 = !DILocation(line: 24, column: 26, scope: !34
!39 = !DILocalVariable(name: "x2", scope: !26, file: !1, line: 20, type: !4)
!40 = !DILocation(line: 25, column: 22, scope: !34)
!41 = !DILocation(line: 25, column: 17, scope: !34)
!42 = !DILocalVariable(name: "w", scope: !26, file: !1, line: 20, type: !4)
!43 = !DILocation(line: 26, column: 14, scope: !26)
!44 = !DILocation(line: 26, column: 3, scope: !34)
!45 = distinct !{!45, !32, !46, !47}
!46 = !DILocation(line: 26, column: 20, scope: !26)
!49 = !DILocation(line: 28, column: 18, scope: !26]
!50 = !DILocation(line: 28, column: 30, scope: !26)
!51 = !DILocation(line: 28, column: 28, scope: !26
!52 = !DILocation(line: 28, column: 12, scope: !26)
153 = IDII ocation(line: 28, column: 7, scope: 126)
!54 = !DILocation(line: 29, column: 16, scope: !26)
!55 = !DILocation(line: 29, column: 11, scope: !26]
!56 = !DILocation(line: 30, column: 16, scope: !26]
!57 = !DILocation(line: 30, column: 3, scope: !26)
```

IR metadata after Simplify CFG

!58 = !DILocation(line: 30, column: 11, scope: !26) !59 = !DILocation(line: 31, column: 1, scope: !26)

```
Logical View:
[000]
             {File} 'simplify-cfg.ll'
[001]
               {CompileUnit} 'test.cpp'
[002]
                 {TypeAlias} 'U32' -> 'unsigned int'
[002]
                 {TypeAlias} 'F32' -> 'float'
[002]
                 {Function} 'RandF32' -> 'float'
[003]
                    {Variable} 'uRand' -> 'U32'
       14
[003]
                    {Variable} 'fRand' -> 'F32'
[003]
                    {Line}
[003]
                    {Line}
[003]
                    {Line}
[003]
                    {Line}
[002]
                 {Function} 'randGauss' -> 'void'
[003]
                    {Parameter} 'work' -> '* float
[003]
       20
                    {Variable} 'w' -> 'float'
[003]
                    {Variable} 'x1' -> 'float'
[003]
       20
                    {Variable} 'x2' -> 'float'
[003]
       28
                    {Line}
[003]
                    {Line}
[003]
       30
                    {Line}
[003]
                    {Line}
[003]
                    {Line}
[003]
                    {Line}
[003]
                    {Line}
[003]
       24
                    {Line}
[003]
                    {Line}
```

Logical view after Simplify CFG

#### Logical views for Simplify CFG and SLP Vectorizer passes





```
!llvm.dba.cu = !(!0)
!llvm.module.flags = !{!5, !6, !7, !8, !9, !10, !11}
Illym ident = 1(112
10 = distinct !DICompileUnit(language: DW_LANG_C_plus_plus_14, file: !1, producer: "clang", isOptimized: false, runtimeVersion: 0,
emissionKind: FullDebug, retainedTypes: !2, splitDebugInlining: false, nameTableKind: None)
!1 = !DIFile(filename: "test.cop", directory:
!3 = !DIDerivedType(tag: DW_TAG_typedef, name: "F32", file: !1, line: 7, baseType: !4)
!4 = !DIBasicType(name: "float", size: 32, encoding: DW_ATE_float)
15 = 1(i32 7 1"Dwarf Version" i32 5)
!6 = !(i32 2, !"Debug Info Version", i32 3)
!12 = !{!"clang"}
113 = distinct IDISubprogram(name: "RandF32", linkageName: ", Z7RandF32v", scope: 11, file: 11, line: 13, type: 114, scopeLine: 13, flags
DIFlagPrototyped, spFlags: DISPFlagDefinition, unit: 10, retainedNodes: 116)
!14 = !DISubroutineType(types: !15)
!17 = !DILocation(line: 14, column: 15, scope: !13)
!18 = !DILocalVariable(name: "uRand", scope: !13, file: !1, line: 14, type: !19)
!19 = !DIDerivedType(tag: DW_TAG_typedef, name: "U32", file: !1, line: 6, baseType: !20)
!20 = !DIBasicType(name: "unsigned int", size: 32, encoding: DW_ATE_unsigned)
!21 = !DILocation(line: 0, scope: !13)
122 = IDILocation(line: 15, column: 21, scope: !13)
!23 = !DILocation(line: 15, column: 27, scope: !13)
!24 = !DILocalVariable(name: "fRand", scope: !13, file: !1, line: 15, type: !3)
!25 = !DILocation(line: 16, column: 3, scope: !13)
!26 = distinct!DISubprogram(name: "randGauss", linkageName: " Z9randGaussPf", scope: !1, file: !1, line: 19, type: !27, scopeLine: 19,
flags: DIFlagPrototyped, spFlags: DISPFlagDefinition, unit: 10, retainedNodes: 116)
!27 = !DISubroutineType(types: !28)
!28 = !{null, !29}
!29 = !DIDerivedType(tag: DW_TAG_pointer_type, baseType: !4, size: 64)
!30 = !DILocalVariable(name: "work", arg: 1, scope: !26, file: !1, line: 19, type: !29)
!31 = !DILocation(line: 0, scope: !26)
!32 = !DILocation(line: 22, column: 3, scope: !26)
133 = IDII ocation/line: 23 column: 16 scope: (34)
!34 = distinct !DILexicalBlock(scope: !26, file: !1, line: 22, column: 6)
!35 = !DILocation(line: 23, column: 26, scope: !34)
!36 = !DILocalVariable(name: "x1", scope: !26, file: !1, line: 20, type: !4)
!37 = !DILocation(line: 24, column: 16, scope: !34]
!38 = !DILocation(line: 24, column: 26, scope: !34
!39 = !DILocalVariable(name: "x2", scope: !26, file: !1, line: 20, type: !4)
!40 = !DILocation(line: 25, column: 22, scope: !34)
!41 = !DILocation(line: 25, column: 17, scope: !34)
!42 = !DILocalVariable(name: "w", scope: !26, file: !1, line: 20, type: !4)
!43 = !DILocation(line: 26, column: 14, scope: !26)
!44 = !DILocation(line: 26, column: 3, scope: !34)
!45 = distinct !{!45, !32, !46, !47}
!46 = !DILocation(line: 26, column: 20, scope: !26)
!47 = !{!*llvm.loop.mustprogress*}
!49 = !DILocation(line: 28, column: 18, scope: !26]
!50 = !DILocation(line: 28, column: 30, scope: !26)
!51 = !DILocation(line: 28, column: 28, scope: !26
!52 = !DILocation(line: 28, column: 12, scope: !26]
153 = IDII ocation(line: 28, column: 7, scope: 126).
!54 = !DILocation(line: 29, column: 16, scope: !26]
!55 = !DILocation(line: 29, column: 11, scope: !26]
!56 = !DILocation(line: 30, column: 16, scope: !26]
!57 = !DILocation(line: 30, column: 3, scope: !26)
!58 = !DILocation(line: 30, column: 11, scope: !26)
```

IR metadata after Simplify CFG

!59 = !DILocation(line: 31, column: 1, scope: !26)

```
Logical View:
[000]
             {File} 'simplify-cfg.ll'
[001]
                {CompileUnit} 'test.cpp'
[002]
                 {TypeAlias} 'U32' -> 'unsigned int'
[002]
                 {TypeAlias} 'F32' -> 'float'
[002]
                 {Function} 'RandF32' -> 'float'
[003]
                    {Variable} 'uRand' -> 'U32'
[003]
                    {Variable} 'fRand' -> 'F32'
[003]
                    {Line}
[003]
                    {Line}
[003]
                    {Line}
[003]
                    {Line}
[002]
                 {Function} 'randGauss' -> 'void'
[003]
                    {Parameter} 'work' -> '* float
[003]
                    {Variable} 'w' -> 'float'
[003]
                    {Variable} 'x1' -> 'float'
                    {Variable} 'x2' -> 'float'
[003]
       20
[003]
                    {Line}
[003]
                    {Line}
[003]
                    {Line}
[003]
       30
                    {Line}
[003]
                    {Line}
[003]
                    {Line}
[003]
                    {Line}
[003]
       24
                    {Line}
[003]
                    {Line}
```

```
Logical View:
[000]
             {File} 'slp-vectorizer.ll'
[001]
               {CompileUnit} 'test.cpp'
[002]
                 {TypeAlias} 'U32' -> 'unsigned int'
[002]
                 {TypeAlias} 'F32' -> 'float'
[002]
                 {Function} 'RandF32' -> 'float'
[003]
      14
                   {Variable} 'uRand' -> 'U32'
[003]
                   {Variable} 'fRand' -> 'F32'
[003]
      14
                   {Line}
[003]
      15
                   {Line}
[003]
      15
                   {Line}
[003]
      16
                   {Line}
[002]
      19
                 {Function} 'randGauss' -> 'void'
[003]
      19
                   {Parameter} 'work' -> '* float
[003]
      20
                   {Variable} 'w' -> 'float'
[003]
      28
                   {Line}
      29
[003]
                   {Line}
[003]
      29
                   {Line}
[003]
      29
                   {Line}
[003]
      31
                   {Line}
[003]
      23
                   {Line}
[003]
                   {Line}
[003]
                   {Line}
[003]
                   {Line}
[003]
                   {Line}
```

Logical view after Simplify CFG

Logical view after SLP Vectorizer

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33

## **Compare logical views**





Common options to compare logical views when dealing with IR

- --report=list --report=view
- --print=scopes,types,symbols,lines

## **Compare logical views**





Common options to compare logical views when dealing with IR

- --report=list --report=view
- --print=scopes,types,symbols,lines

#### IR tests

- After Simplify CFG pass: simplify-cfg.ll
- After SLP Vectorizer pass: slp-vectorizer.ll

## **Compare logical views**





#### Common options to compare logical views when dealing with IR

- --report=list --report=view
- --print=scopes,types,symbols,lines

#### IR tests

- After Simplify CFG pass: simplify-cfg.ll
- After SLP Vectorizer pass: slp-vectorizer.ll

#### Ilvm-debuginfo-analyzer command line

- --compare=symbols,lines --report=list --print=symbols,lines simplify-cfg.ll slp-vectorizer.ll
- --compare=symbols,lines --report=view --print=symbols simplify-cfg.ll slp-vectorizer.ll

## **Logical view changes - comparison tool**





| _       | 40.0           |                                     |             | 1 1      | 9 9 9 9 <del>9   •  </del>          |     |  |  |
|---------|----------------|-------------------------------------|-------------|----------|-------------------------------------|-----|--|--|
|         |                | simplify-cfg.view =                 |             |          | slp-vectorizer.view                 | =   |  |  |
| Logical | View.          |                                     | Logical     | View.    |                                     |     |  |  |
| [000]   | 12000          | (File) 'simplify-cfg.11'            | [0001       | 12001    | {File} 'slp-vectorizer.11'          | _   |  |  |
|         |                | (,                                  |             |          | (,                                  |     |  |  |
| [001]   |                | (CompileUnit) 'test.cpp'            | [001]       |          | (CompileUnit) 'test.cpp'            |     |  |  |
| [002]   | 6              | {TypeAlias} 'U32' -> 'unsigned int' | [002]       | 6        | {TypeAlias} 'U32' -> 'unsigned int' |     |  |  |
| [002]   | 7              | (TypeAlias) 'F32' -> 'float'        | [002]       | 7        | {TypeAlias} 'F32' -> 'float'        |     |  |  |
| [002]   | 13             | (Function) extern not_inlined       | [002]       | 13       | (Function) extern not_inlined       |     |  |  |
| 'RandF3 |                |                                     |             |          | 'RandF32' -> 'float'                |     |  |  |
| [003]   | 14             | {Variable} 'uRand' -> 'U32'         | [003]       | 14       | {Variable} 'uRand' -> 'U32'         |     |  |  |
| [003]   | 15             | (Variable) 'fRand' -> 'F32'         | [003]       | 15       | (Variable) 'fRand' -> 'F32'         |     |  |  |
| [003]   | 14             | {Line}                              | [003]       | 14       | {Line}                              |     |  |  |
| [003]   | 15             | {Line}                              | [003]       | 15       | {Line}                              |     |  |  |
| [003]   | 15             | (Line)                              | [003]       | 15       | (Line)                              |     |  |  |
| [003]   | 16             | {Line}                              | [003]       | 16       | {Line}                              |     |  |  |
| [002]   | 19             | {Function} extern not_inlined       | [002]       | 19       | {Function} extern not_inlined       |     |  |  |
|         |                |                                     |             |          | > 'void'                            |     |  |  |
| [003]   | 19             | {Parameter} 'work' -> '* float'     | [003]       | 19       | {Parameter} 'work' -> '* float'     |     |  |  |
| [003]   | 20             | {Variable} 'w' -> 'float'           | [003]       | 20       | {Variable} 'w' -> 'float'           |     |  |  |
| [003]   | 20             | (Variable) 'x1' -> 'float'          |             |          |                                     |     |  |  |
| [003]   | 20             | {Variable} 'x2' -> 'float'          |             |          |                                     |     |  |  |
| [003]   | 22             | {Line}                              | [003]       | 22       | {Line}                              |     |  |  |
| [003]   | 26             | {Line}                              | [003]       | 26       | (Line)                              |     |  |  |
| [003]   | 28             | {Line}                              | [003]       | 28       | {Line}                              |     |  |  |
| [003]   | 28             | {Line}                              | [003]       | 28       | {Line}                              |     |  |  |
| [003]   | 28             | (Line)                              | [003]       | 28       | (Line)                              |     |  |  |
| [003]   | 28             | {Line}                              | [003]       | 28       | (Line)                              |     |  |  |
| [003]   | 28             | {Line}                              | [003]       | 28       | {Line}                              |     |  |  |
| [003]   | 28             | (Line)                              | [003]       | 28       | (Line)                              |     |  |  |
| [003]   | 28             | {Line}                              | [003]       | 28       | (Line)                              |     |  |  |
| [003]   | 29             | {Line}                              | [003]       | 29       | (Line)                              |     |  |  |
| [003]   | 29<br>30       | (Line)                              | [003]       | 29<br>29 | {Line}                              | _   |  |  |
| [003]   | 30             | (Line)                              | [003]       | 29       | (Line)                              |     |  |  |
| 4       |                |                                     | 4           |          |                                     | P , |  |  |
|         | /49 Ch: 1/49 E | OL: LF Windows-1252 Unix            | Line: 17-18 |          | Windows-1252 Unix                   |     |  |  |
| × [003] | 20             | {Variable} 'x1' -> 'float'          |             |          |                                     |     |  |  |
| [003]   | 20             | {Variable} 'x2' -> 'float'          |             |          |                                     | 1   |  |  |
|         |                |                                     |             |          |                                     | 1   |  |  |
|         |                |                                     |             |          |                                     |     |  |  |
|         |                |                                     |             |          |                                     |     |  |  |
|         |                |                                     |             |          |                                     |     |  |  |

IR changes: comparison tool

#### Logical view changes - built-in compare (report mode)





```
simplify-cfq.view
                                                                                              slp-vectorizer.view
Logical View:
                                                                   Logical View:
                  {File} 'simplify-cfq.ll
                                                                                     {File} 'slp-vectorizer.ll
[001]
                    {CompileUnit} 'test.cpp'
                                                                    [001]
                                                                                        (CompileUnit) 'test.cpp'
[002]
           6
                      {TypeAlias} 'U32' -> 'unsigned int'
                                                                    [002]
                                                                                          {TypeAlias} 'U32' -> 'unsigned int'
          7
[002]
                      (TypeAlias) 'F32' -> 'float'
                                                                    [002]
                                                                                          {TypeAlias} 'F32' -> 'float'
[002]
         13
                      (Function) extern not inlined
                                                                    [002]
                                                                             13
                                                                                          (Function) extern not inlined
'RandF32' -> 'float'
                                                                    'RandF32' -> 'float'
[003]
          14
                        {Variable} 'uRand' -> 'U32'
                                                                    [003]
                                                                             14
                                                                                            {Variable} 'uRand' -> 'U32'
[003]
          15
                        (Variable) 'fRand' -> 'F32'
                                                                   [003]
                                                                             15
                                                                                            (Variable) 'fRand' -> 'F32'
[003]
          14
                        {Line}
                                                                   [003]
                                                                                            {Line}
[003]
          15
                        {Line}
                                                                    [003]
                                                                             15
                                                                                            {Line}
[003]
          15
                        (Line)
                                                                    10031
                                                                             15
                                                                                            (Line
[003]
          16
                        {Line}
                                                                    [003]
                                                                                            {Line}
[002]
          19
                                                                    [002]
                                                                             19
                                                                                          {Function} extern not inlined
                      {Function} extern not inlined
'randGauss' -> 'void'
                                                                    'randGauss'
                                                                                -> 'void'
[003]
          19
                        {Parameter} 'work' -> '* float'
                                                                   [003]
                                                                             19
                                                                                            {Parameter} 'work' -> '* float'
[003]
         20
                        {Variable} 'w' -> 'float'
                                                                    [003]
                                                                             20
                                                                                            {Variable} 'w' -> 'float'
[003]
                        (Variable) 'x1' -> 'float'
          20
                        {Variable} 'x2' -> 'float'
[003]
          22
                        {Line}
                                                                   [003]
                                                                                            {Line}
10031
          26
                        (Line)
                                                                    10031
                                                                             26
                                                                                            (Line)
[003]
          28
                                                                   [003]
                                                                             28
                                                                                            {Line}
                        {Line}
[003]
                                                                   [003]
                        {Line}
                                                                                            {Line}
[003]
         28
                        {Line}
                                                                   [003]
                                                                             28
                                                                                            (Line)
[003]
         28
                        {Line}
                                                                   [003]
                                                                             28
                                                                                            {Line
[003]
          28
                                                                    [0031
                                                                                            {Line}
                        {Line}
[003]
          28
                        {Line}
                                                                   10031
                                                                             28
                                                                                            (Line)
[003]
          28
                        {Line}
                                                                   [003]
                                                                             28
                                                                                            {Line
[003]
          29
                                                                   10031
                        {Line}
                                                                                            {Line}
[003]
         29
                        {Line}
                                                                    [003]
                                                                             29
                                                                                            {Line}
                         {Line}
                                                                    [003]
                                                                                            {Line}
Ln: 18 Col: 1/49 Ch: 1/49 EOL: LF
                                                                   Line: 17-18
                                                                                                                 Windows-1252
                                                                                                                              Unix
                                             Windows-1252
  [003]
           20
                          {Variable} 'x1' -> 'float'
           20
  10031
                          {Variable} 'x2' -> 'float'
```

```
Reference: 'simplify-cfg.11'
Target:
           'slp-vectorizer.ll'
```

IR changes: comparison tool

IR changes: Ilvm-debuginfo-analyzer

#### Logical view changes - built-in compare (report mode)





```
simplify-cfq.view
                                                                                              slp-vectorizer.view
Logical View:
                                                                   Logical View:
                  {File} 'simplify-cfq.ll
                                                                                     {File} 'slp-vectorizer.ll
[001]
                    {CompileUnit} 'test.cpp'
                                                                    [001]
                                                                                       (CompileUnit) 'test.cpp'
[002]
           6
                      {TypeAlias} 'U32' -> 'unsigned int'
                                                                    [002]
                                                                                          {TypeAlias} 'U32' -> 'unsigned int'
          7
[002]
                      (TypeAlias) 'F32' -> 'float'
                                                                    [002]
                                                                                          {TypeAlias} 'F32' -> 'float'
[002]
         13
                      (Function) extern not inlined
                                                                    [002]
                                                                             13
                                                                                          (Function) extern not inlined
'RandF32' -> 'float'
                                                                    'RandF32' -> 'float'
[003]
          14
                        {Variable} 'uRand' -> 'U32'
                                                                    [003]
                                                                             14
                                                                                            {Variable} 'uRand' -> 'U32'
[003]
          15
                        (Variable) 'fRand' -> 'F32'
                                                                   [003]
                                                                             15
                                                                                            (Variable) 'fRand' -> 'F32'
[003]
         14
                        {Line}
                                                                   [003]
                                                                                            {Line}
[003]
          15
                        {Line}
                                                                    [003]
                                                                             15
                                                                                            {Line}
10031
          15
                        (Line)
                                                                    10031
                                                                             15
                                                                                            (Line
[003]
          16
                        {Line}
                                                                    [003]
                                                                                            {Line}
[002]
         19
                                                                    [002]
                                                                             19
                                                                                          {Function} extern not inlined
                      {Function} extern not inlined
'randGauss' -> 'void'
                                                                    'randGauss' -> 'void'
                                                                                            {Parameter} 'work' -> '* float'
[003]
          19
                        {Parameter} 'work' -> '* float'
                                                                   [003]
                                                                             19
                                                                                            {Variable} 'w' -> 'float'
[003]
         20
                        {Variable} 'w' -> 'float'
                                                                    [003]
                                                                             20
[003]
                        (Variable) 'x1' -> 'float'
          20
                        {Variable} 'x2' -> 'float'
[003]
          22
                        {Line}
                                                                   [003]
                                                                                            {Line}
10031
          26
                        (Line)
                                                                    10031
                                                                             26
                                                                                            (Line)
[003]
         28
                                                                   [003]
                                                                             28
                                                                                            {Line}
                        {Line}
[003]
                                                                   [003]
                        {Line}
                                                                                            {Line}
[003]
         28
                        {Line}
                                                                   [003]
                                                                             28
                                                                                            (Line)
[003]
         28
                        {Line}
                                                                   [003]
                                                                             28
                                                                                            {Line
[003]
          28
                                                                    [0031
                                                                                            {Line}
                        {Line}
[003]
          28
                        {Line}
                                                                   10031
                                                                             28
                                                                                            (Line)
[003]
          28
                        {Line}
                                                                   [003]
                                                                             28
                                                                                            {Line}
[003]
          29
                                                                   10031
                        {Line}
                                                                                            {Line}
[003]
         29
                        {Line}
                                                                    [003]
                                                                             29
                                                                                            {Line}
                         {Line}
                                                                    [003]
                                                                                            {Line}
Ln: 18 Col: 1/49 Ch: 1/49 EOL: LF
                                                                   Line: 17-18
                                                                                                                 Windows-1252
                                                                                                                              Unix
                                             Windows-1252
  [003]
           20
                          {Variable} 'x1' -> 'float'
           20
  10031
                          {Variable} 'x2' -> 'float'
```

```
Reference: 'simplify-cfg.11'
           'slp-vectorizer.11'
Target:
(2) Missing Symbols:
     20
            {Variable} 'x1' -> 'float'
            {Variable} 'x2' -> 'float'
```

IR changes: comparison tool

IR changes: Ilvm-debuginfo-analyzer

#### Logical view changes - built-in compare (report mode)





```
simplify-cfq.view
                                                                                              slp-vectorizer.view
Logical View:
                                                                   Logical View:
                  {File} 'simplify-cfq.ll
                                                                                     {File} 'slp-vectorizer.ll
[001]
                    {CompileUnit} 'test.cpp'
                                                                    [001]
                                                                                        (CompileUnit) 'test.cpp'
[002]
           6
                      {TypeAlias} 'U32' -> 'unsigned int'
                                                                    [002]
                                                                                          {TypeAlias} 'U32' -> 'unsigned int'
          7
[002]
                      {TypeAlias} 'F32' -> 'float'
                                                                    [002]
                                                                                          {TypeAlias} 'F32' -> 'float'
[002]
         13
                      (Function) extern not inlined
                                                                    [002]
                                                                             13
                                                                                          (Function) extern not inlined
'RandF32' -> 'float'
                                                                    'RandF32' -> 'float'
[003]
          14
                        {Variable} 'uRand' -> 'U32'
                                                                    [003]
                                                                             14
                                                                                            {Variable} 'uRand' -> 'U32'
[003]
          15
                        (Variable) 'fRand' -> 'F32'
                                                                   [003]
                                                                             15
                                                                                            (Variable) 'fRand' -> 'F32'
[003]
         14
                        {Line}
                                                                   [003]
                                                                                            {Line}
[003]
          15
                        {Line}
                                                                    [003]
                                                                             15
                                                                                            {Line}
10031
          15
                        (Line)
                                                                    10031
                                                                                            (Line
[003]
          16
                        {Line}
                                                                    [003]
[002]
          19
                                                                    [002]
                                                                             19
                                                                                          {Function} extern not inlined
                      {Function} extern not inlined
'randGauss' -> 'void'
                                                                    'randGauss' -> 'void'
                                                                                            {Parameter} 'work' -> '* float'
[003]
          19
                        {Parameter} 'work' -> '* float'
                                                                   [003]
[003]
         20
                        {Variable} 'w' -> 'float'
                                                                    [003]
                                                                             20
                                                                                            {Variable} 'w' -> 'float'
[003]
                        (Variable) 'x1' -> 'float'
          20
                        {Variable} 'x2' -> 'float'
[003]
          22
                        {Line}
                                                                   [003]
                                                                                            {Line}
10031
          26
                        (Line)
                                                                    10031
                                                                             26
                                                                                            (Line)
[003]
         28
                        {Line}
                                                                   [003]
                                                                             28
                                                                                            {Line}
[003]
                                                                   [003]
                        {Line}
                                                                                            {Line}
[003]
         28
                        {Line}
                                                                   [003]
                                                                             28
                                                                                            (Line)
[003]
         28
                        {Line}
                                                                   [003]
                                                                             28
                                                                                            {Line
[003]
          28
                                                                    [0031
                                                                                            {Line}
                        {Line}
[003]
          28
                        {Line}
                                                                   10031
                                                                             28
                                                                                            (Line)
[003]
          28
                        {Line}
                                                                   [003]
                                                                             28
                                                                                            {Line}
[003]
          29
                                                                   10031
                                                                             29
                        {Line}
                                                                                            {Line}
[003]
         29
                        {Line}
                                                                    [003]
                                                                             29
                                                                                            {Line}
         30
                         {Line}
                                                                    [003]
                                                                                            {Line}
Ln: 18 Col: 1/49 Ch: 1/49 EOL: LF
                                                                   Line: 17-18
                                                                                                                 Windows-1252
                                                                                                                              Unix
                                             Windows-1252
  [003]
           20
                          {Variable} 'x1' -> 'float'
           20
  10031
                          {Variable} 'x2' -> 'float'
```

```
Reference: 'simplify-cfg.11'
           'slp-vectorizer.11'
Target:
(2) Missing Symbols:
     20
             {Variable} 'x1' -> 'float'
            {Variable} 'x2' -> 'float'
(5) Missing Lines:
     24
             {Line}
            {Line}
            {Line}
     30
            {Line}
     24
            {Line}
```

IR changes: comparison tool

IR changes: Ilvm-debuginfo-analyzer

#### Logical view changes - built-in compare (view mode)





```
simplify-cfq.view
                                                                                              slp-vectorizer.view
Logical View:
                                                                   Logical View:
                  {File} 'simplify-cfq.ll
                                                                                     {File} 'slp-vectorizer.ll
[001]
                    {CompileUnit} 'test.cpp'
                                                                    [001]
                                                                                       (CompileUnit) 'test.cpp'
[002]
           6
                      {TypeAlias} 'U32' -> 'unsigned int'
                                                                    [002]
                                                                                          {TypeAlias} 'U32' -> 'unsigned int'
          7
[002]
                      (TypeAlias) 'F32' -> 'float'
                                                                    [002]
                                                                                          {TypeAlias} 'F32' -> 'float'
[002]
         13
                      (Function) extern not inlined
                                                                    [002]
                                                                             13
                                                                                          (Function) extern not inlined
'RandF32' -> 'float'
                                                                    'RandF32' -> 'float'
[003]
          14
                        {Variable} 'uRand' -> 'U32'
                                                                    [003]
                                                                             14
                                                                                            {Variable} 'uRand' -> 'U32'
[003]
          15
                        (Variable) 'fRand' -> 'F32'
                                                                   10031
                                                                             15
                                                                                            (Variable) 'fRand' -> 'F32'
[003]
         14
                        {Line}
                                                                   [003]
                                                                                            {Line}
[003]
          15
                        {Line}
                                                                    [003]
                                                                             15
                                                                                            {Line}
10031
          15
                        (Line)
                                                                    10031
                                                                                            (Line
[003]
          16
                        {Line}
                                                                    [003]
[002]
         19
                                                                    [002]
                                                                             19
                                                                                          {Function} extern not inlined
                      {Function} extern not inlined
'randGauss' -> 'void'
                                                                    'randGauss' -> 'void'
[003]
          19
                        {Parameter} 'work' -> '* float'
                                                                   [003]
                                                                             19
                                                                                            {Parameter} 'work' -> '* float'
[003]
         20
                        {Variable} 'w' -> 'float'
                                                                    [003]
                                                                             20
                                                                                            {Variable} 'w' -> 'float'
[003]
                        (Variable) 'x1' -> 'float'
         20
                        {Variable} 'x2' -> 'float'
[003]
          22
                        {Line}
                                                                   [003]
                                                                                            {Line}
10031
          26
                        (Line)
                                                                    10031
                                                                             26
                                                                                            (Line)
[003]
         28
                        {Line}
                                                                   [003]
                                                                             28
                                                                                            {Line}
[003]
                                                                   [003]
                        {Line}
                                                                                            {Line}
[003]
         28
                        {Line}
                                                                   [003]
                                                                             28
                                                                                            (Line)
[003]
         28
                        {Line}
                                                                   [003]
                                                                             28
                                                                                            {Line}
[003]
          28
                                                                    [0031
                                                                                            {Line}
                        {Line}
[003]
          28
                        {Line}
                                                                   10031
                                                                             28
                                                                                            (Line)
[003]
         28
                        {Line}
                                                                   [003]
                                                                             28
                                                                                            {Line}
[003]
          29
                                                                   10031
                                                                             29
                        {Line}
                                                                                            {Line}
[003]
         29
                        {Line}
                                                                    [003]
                                                                             29
                                                                                            {Line}
         30
                         {Line}
                                                                    [003]
                                                                                            {Line}
Ln: 18 Col: 1/49 Ch: 1/49 EOL: LF
                                                                   Line: 17-18
                                                                                                                 Windows-1252
                                                                                                                              Unix
                                             Windows-1252
  [003]
           2.0
                          {Variable} 'x1' -> 'float'
           20
  10031
                          {Variable} 'x2' -> 'float'
```

```
Reference: 'simplify-cfg.11'
           'slp-vectorizer.11'
Target:
(2) Missing Symbols:
     20
             {Variable} 'x1' -> 'float'
            {Variable} 'x2' -> 'float'
(5) Missing Lines:
     24
             {Line}
            {Line}
            {Line}
     30
            {Line}
     24
            {Line}
Reference: 'simplify-cfg.ll'
            'slp-vectorizer.ll'
Target:
```

IR changes: comparison tool

IR changes: Ilvm-debuginfo-analyzer

#### Logical view changes - built-in compare (view mode)





```
simplify-cfq.view
                                                                                              slp-vectorizer.view
Logical View:
                                                                   Logical View:
                  {File} 'simplify-cfq.ll
                                                                                     {File} 'slp-vectorizer.ll
[001]
                    {CompileUnit} 'test.cpp'
                                                                   [001]
                                                                                       (CompileUnit) 'test.cpp'
[002]
           6
                      {TypeAlias} 'U32' -> 'unsigned int'
                                                                   [002]
                                                                                          {TypeAlias} 'U32' -> 'unsigned int'
          7
[002]
                      (TypeAlias) 'F32' -> 'float'
                                                                   [002]
                                                                                          {TypeAlias} 'F32' -> 'float'
[002]
         13
                      (Function) extern not inlined
                                                                   [002]
                                                                             13
                                                                                          (Function) extern not inlined
'RandF32' -> 'float'
                                                                   'RandF32' -> 'float'
[003]
          14
                        {Variable} 'uRand' -> 'U32'
                                                                             14
                                                                                           {Variable} 'uRand' -> 'U32'
[003]
          15
                        (Variable) 'fRand' -> 'F32'
                                                                   10031
                                                                             15
                                                                                           (Variable) 'fRand' -> 'F32'
[003]
         14
                        {Line}
                                                                   [003]
                                                                                           {Line}
[003]
          15
                        {Line}
                                                                   [003]
                                                                             15
                                                                                           {Line}
10031
          15
                        (Line)
                                                                   10031
                                                                             15
                                                                                           (Line
[003]
         16
                        {Line}
                                                                   [003]
                                                                             16
[002]
         19
                      {Function} extern not inlined
                                                                   [002]
                                                                             19
                                                                                          {Function} extern not inlined
'randGauss' -> 'void'
                                                                   'randGauss' -> 'void'
                                                                                           {Parameter} 'work' -> '* float'
[003]
          19
                        {Parameter} 'work' -> '* float'
                                                                   [003]
                                                                             19
[003]
         20
                        {Variable} 'w' -> 'float'
                                                                   [003]
                                                                             20
                                                                                           {Variable} 'w' -> 'float'
[003]
                        (Variable) 'x1' -> 'float'
         20
                        {Variable} 'x2' -> 'float'
[003]
          22
                        {Line}
                                                                   [003]
                                                                                           {Line}
10031
         26
                        (Line)
                                                                   10031
                                                                             26
                                                                                           (Line)
[003]
         28
                        {Line}
                                                                   [003]
                                                                             28
                                                                                           {Line}
[003]
                                                                   [003]
                        {Line}
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[003]
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                        {Line}
                                                                   [003]
                                                                             28
                                                                                           (Line)
[003]
         28
                        {Line}
                                                                   [003]
                                                                             28
                                                                                           {Line}
[003]
          28
                                                                   [0031
                                                                                           {Line}
                        {Line}
[003]
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                        {Line}
                                                                   10031
                                                                             28
                                                                                           (Line)
[003]
         28
                        {Line}
                                                                   [003]
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                                                                                           {Line}
[003]
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                                                                   10031
                                                                             29
                        {Line}
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[003]
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                        {Line}
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                                                                                           {Line}
         30
                        {Line}
                                                                   [003]
                                                                                           {Line}
Ln: 18 Col: 1/49 Ch: 1/49 EOL: LF
                                                                   Line: 17-18
                                                                                                                 Windows-1252
                                                                                                                              Unix
                                             Windows-1252
  [003]
           2.0
                          {Variable} 'x1' -> 'float'
           20
  10031
                          {Variable} 'x2' -> 'float'
```

```
Reference: 'simplify-cfg.ll'
           'slp-vectorizer.11'
Target:
(2) Missing Symbols:
     20
            {Variable} 'x1' -> 'float'
            {Variable} 'x2' -> 'float'
(5) Missing Lines:
     24
            {Line}
            {Line}
            {Line}
     30
            {Line}
     24
            {Line}
Reference: 'simplify-cfg.ll'
           'slp-vectorizer.ll'
Target:
Logical View:
            {File} 'simplify-cfg.ll'
              {CompileUnit} 'test.cpp'
                {Function} extern not inlined 'RandF32' -> 'float'
     14
                  {Variable} 'uRand' -> 'U32'
                  {Variable} 'fRand' -> 'F32'
                {Function} extern not inlined 'randGauss' -> 'void'
                  {Parameter} 'work' -> '* float'
     20
                  {Variable} 'w' -> 'float'
```

IR changes: comparison tool

IR changes: Ilvm-debuginfo-analyzer

#### Logical view changes - built-in compare (view mode)





```
simplify-cfq.view
                                                                                              slp-vectorizer.view
Logical View:
                                                                   Logical View:
                  {File} 'simplify-cfq.ll
                                                                                     {File} 'slp-vectorizer.ll
[001]
                    {CompileUnit} 'test.cpp'
                                                                   [001]
                                                                                       (CompileUnit) 'test.cpp'
[002]
           6
                      {TypeAlias} 'U32' -> 'unsigned int'
                                                                   [002]
                                                                                          {TypeAlias} 'U32' -> 'unsigned int'
          7
[002]
                      (TypeAlias) 'F32' -> 'float'
                                                                   [002]
                                                                                          {TypeAlias} 'F32' -> 'float'
[002]
         13
                      (Function) extern not inlined
                                                                   [002]
                                                                             13
                                                                                          (Function) extern not inlined
'RandF32' -> 'float'
                                                                   'RandF32' -> 'float'
[003]
          14
                        {Variable} 'uRand' -> 'U32'
                                                                             14
                                                                                           {Variable} 'uRand' -> 'U32'
[003]
          15
                        (Variable) 'fRand' -> 'F32'
                                                                   10031
                                                                             15
                                                                                           (Variable) 'fRand' -> 'F32'
[003]
         14
                        {Line}
                                                                   [003]
                                                                                           {Line}
[003]
          15
                        {Line}
                                                                   [003]
                                                                             15
                                                                                           {Line}
10031
          15
                        (Line)
                                                                   10031
                                                                             15
                                                                                           (Line
[003]
          16
                        {Line}
                                                                   [003]
                                                                             16
[002]
         19
                                                                   [002]
                                                                             19
                      {Function} extern not inlined
                                                                                          {Function} extern not inlined
'randGauss' -> 'void'
                                                                   'randGauss' -> 'void'
                                                                                           {Parameter} 'work' -> '* float'
[003]
          19
                        {Parameter} 'work' -> '* float'
                                                                   [003]
                                                                             19
[003]
         20
                        {Variable} 'w' -> 'float'
                                                                   [003]
                                                                             20
                                                                                           {Variable} 'w' -> 'float'
[003]
                        (Variable) 'x1' -> 'float'
         20
                        {Variable} 'x2' -> 'float'
[003]
          22
                        {Line}
                                                                   [003]
                                                                                           {Line}
10031
         26
                        (Line)
                                                                   10031
                                                                             26
                                                                                           (Line)
[003]
         28
                        {Line}
                                                                   [003]
                                                                             28
                                                                                           {Line}
[003]
                                                                   [003]
                        {Line}
                                                                                           {Line}
[003]
         28
                        {Line}
                                                                   [003]
                                                                             28
                                                                                           (Line)
[003]
         28
                        {Line}
                                                                   [003]
                                                                             28
                                                                                           {Line}
[003]
          28
                                                                   [0031
                                                                                           {Line}
                        {Line}
[003]
         28
                        {Line}
                                                                   10031
                                                                             28
                                                                                           (Line)
[003]
         28
                        {Line}
                                                                   [003]
                                                                             28
                                                                                           {Line}
[003]
          29
                                                                   10031
                                                                             29
                        {Line}
                                                                                           {Line}
[003]
         29
                        {Line}
                                                                   [003]
                                                                             29
                                                                                           {Line}
         30
                         {Line}
                                                                   [003]
                                                                                           {Line}
Ln: 18 Col: 1/49 Ch: 1/49 EOL: LF
                                                                   Line: 17-18
                                                                                                                 Windows-1252
                                                                                                                              Unix
                                             Windows-1252
  [003]
           2.0
                          {Variable} 'x1' -> 'float'
           20
  10031
                          {Variable} 'x2' -> 'float'
```

```
Reference: 'simplify-cfg.ll'
           'slp-vectorizer.11'
Target:
(2) Missing Symbols:
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            {Variable} 'x1' -> 'float'
            {Variable} 'x2' -> 'float'
(5) Missing Lines:
     24
            {Line}
            {Line}
            {Line}
     30
            {Line}
     24
            {Line}
Reference: 'simplify-cfg.ll'
            'slp-vectorizer.ll'
Target:
Logical View:
            {File} 'simplify-cfg.ll'
              {CompileUnit} 'test.cpp'
                {Function} extern not inlined 'RandF32' -> 'float'
     14
                  {Variable} 'uRand' -> 'U32'
                  {Variable} 'fRand' -> 'F32'
                {Function} extern not inlined 'randGauss' -> 'void'
                  {Parameter} 'work' -> '* float'
     20
                  {Variable} 'w' -> 'float'
                  {Variable} 'x1' -> 'float'
                   {Variable} 'x2' -> 'float'
```

IR changes: comparison tool

IR changes: Ilvm-debuginfo-analyzer

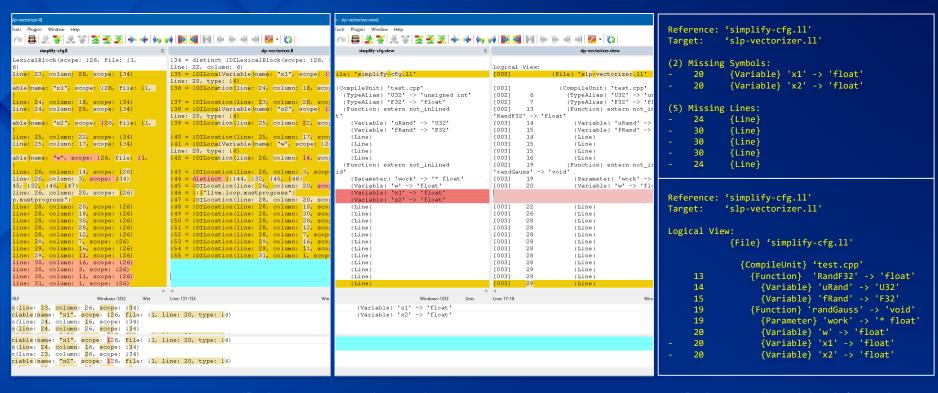


# Conclusion

## Reduce the noisiness of comparing the debuginfo in LLVM IR







IR changes: comparison tool

IR changes: Ilvm-debuginfo-analyzer





# Thank you!