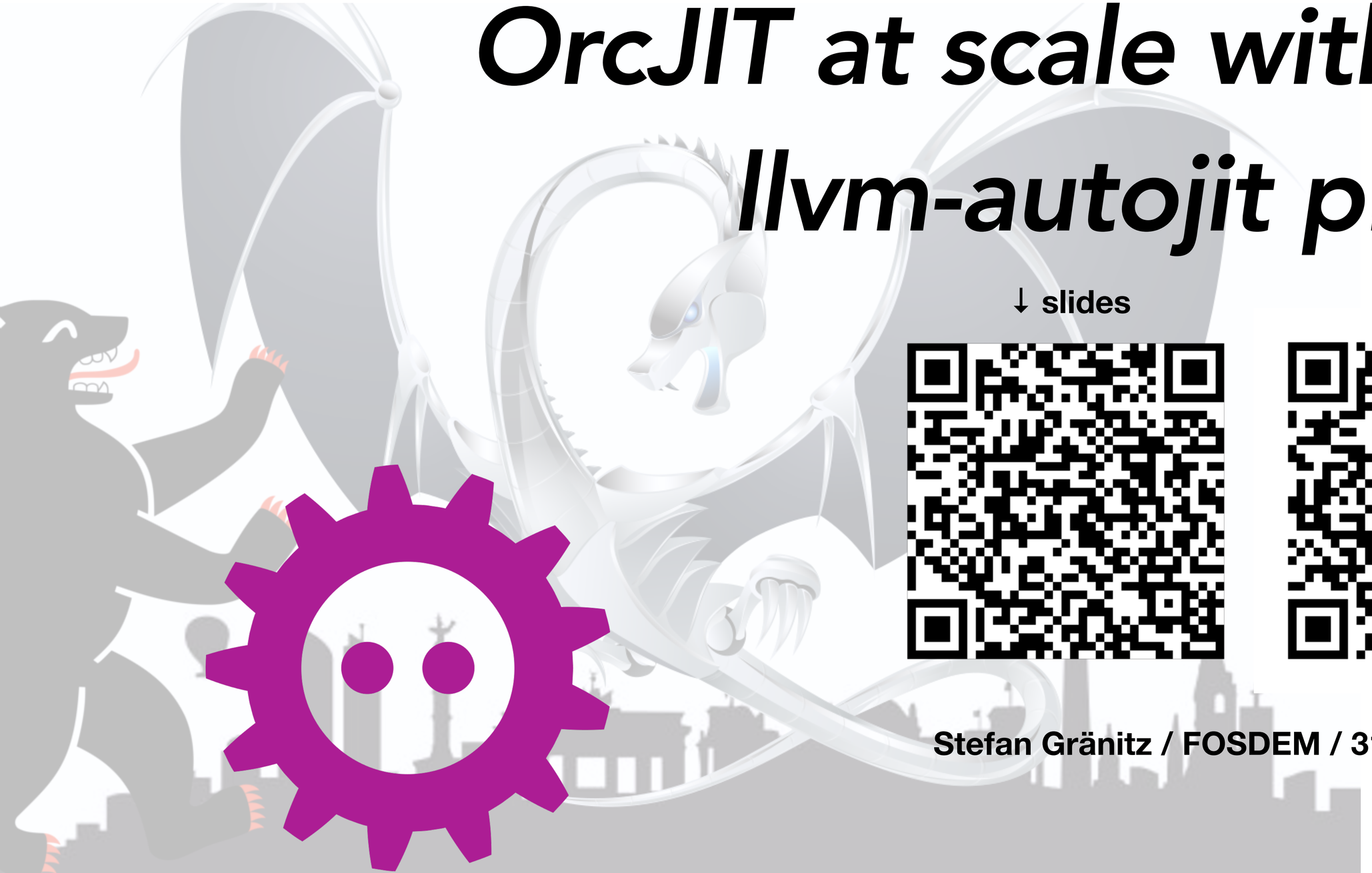


OrcJIT at scale with the llvm-autojit plugin

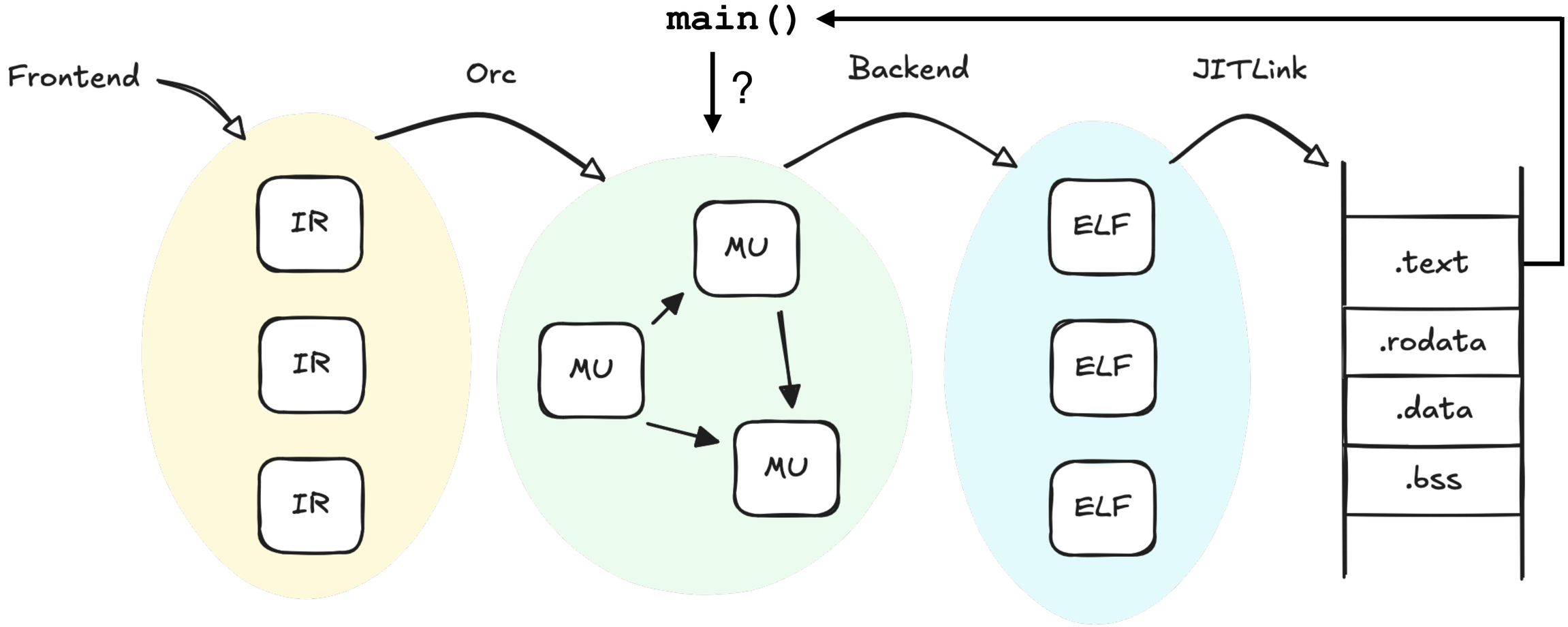
↓ slides

↓ repo

Stefan Gränitz / FOSDEM / 31 January 2026

OrcJIT

In-memory on-request compilation of LLVM IR code



OrcJIT

Hello world example with the llvm interpreter

```
> cat hello.c
#include <stdio.h>

int main(void) {
  printf("hello!\n");
  return 0;
}

> clang -c -emit-llvm hello.c -o hello.bc
> lli hello.bc
hello!
```

OrcJIT

Small C example: bzip2

```
> cd specCPU2006/original/401.bzip2/bzip2-1.0.3
> ls *.c
blocksort.c  bzip2.c  bzip2recover.c  bzlib.c  compress.c  crctable.c
decompress.c  dlltest.c  huffman.c  mk251.c  randtable.c  spewG.c  unzcrash.c

> cat Makefile | wc -l
205

> make CFLAGS="-emit-llvm"
...
```

OrcJIT

Building with make

```
> make CFLAGS="-emit-llvm"
clang-21 -emit-llvm -c blocksort.c
clang-21 -emit-llvm -c huffman.c
clang-21 -emit-llvm -c crctable.c
clang-21 -emit-llvm -c randtable.c
clang-21 -emit-llvm -c compress.c
clang-21 -emit-llvm -c decompress.c
clang-21 -emit-llvm -c bzlib.c
rm -f libbz2.a
llvm-ar-21 cq libbz2.a blocksort.o huffman.o crctable.o randtable.o compress.o decompress.o
bzlib.o
llvm-ar-21: error: blocksort.o: No such file or directory
make: *** [Makefile:35: libbz2.a] Error 1
> ls *.bc
blocksort.bc  bzlib.bc  compress.bc  crctable.bc  decompress.bc  huffman.bc  randtable.bc
```

OrcJIT

Cover the rest of the way on foot

```
> clang-21 -emit-llvm -c bzip2.c

> ls *.bc
blocksort.bc  bzip2.bc   bzlib.bc  compress.bc  crctable.bc  decompress.bc  huffman.bc
randtable.bc

> lli --extra-module=blocksort.bc \
      --extra-module=bzlib.bc \
      --extra-module=compress.bc \
      --extra-module=crctable.bc \
      --extra-module=decompress.bc \
      --extra-module=huffman.bc \
      --extra-module=randtable.bc bzip2.bc --compress data.txt

> ls data.*
data.txt  data.txt.bz2
```

OrcJIT

Cover the rest of the way on foot

```
> clang-21 -emit-llvm -c bzip2.c

> ls *.bc
blocksort.bc  bzip2.bc   bzlib.bc  compress.bc  crctable.bc  decompress.bc  huffman.bc
randtable.bc

> lli --extra-module=blocksort.bc \
      --extra-module=bzlib.bc \
      --extra-module=compress.bc \
      --extra-module=crctable.bc \
      --extra-module=decompress.bc \
      --extra-module=huffman.bc \
      --extra-module=randtable.bc bzip2.bc --compress data.txt

> ls data.*
data.txt  data.txt.bz2
```

We load all code on startup!

OrcJIT

Loads all code on startup

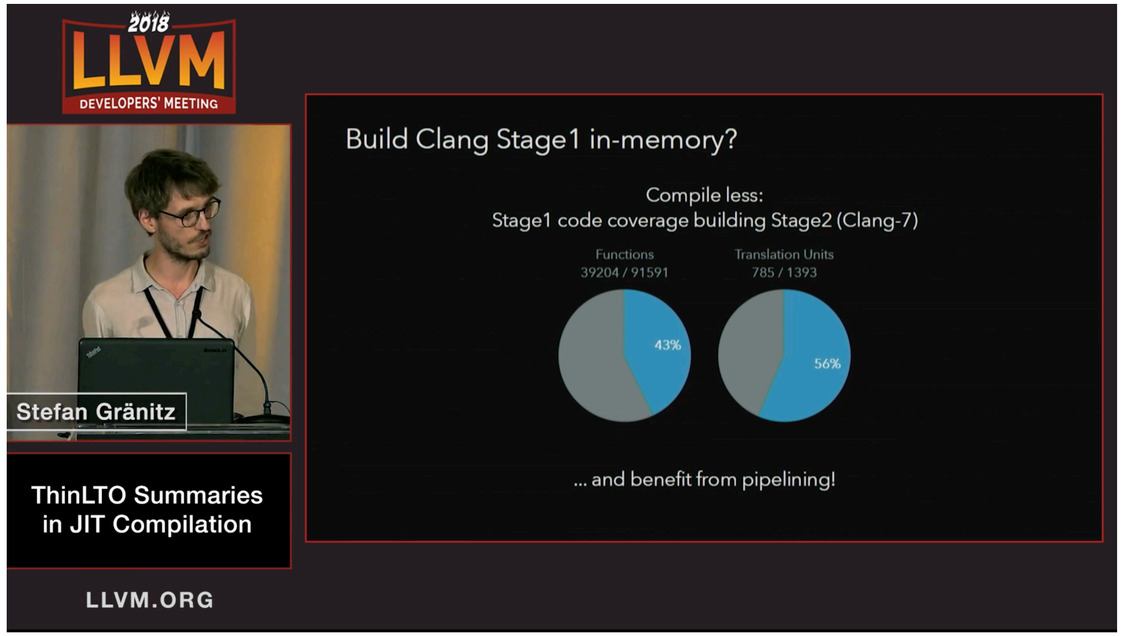
Before entering `main()`

we have to...

- Parse all symbol names
- Allocate global variables
- Initialize global variables

OrcJIT

Loads all code on startup



https://www.youtube.com/watch?v=ZCnHxRhQmvs

Before entering `main()`

we have to...

- Parse all symbol names
- Allocate global variables

} ThinLTO Summaries

- Initialize global variables

OrcJIT

Loads all code on startup

Before entering `main()`

we have to...

- Parse all symbol names
- Allocate global variables
- Initialize global variables

OrcJIT

Loads all code on startup

Before entering `main()`
we have to...

- Parse all symbol names
- Allocate global variables
- Initialize global variables

Status quo:
We load all code on startup!

OrcJIT

Cover the rest of the way on foot

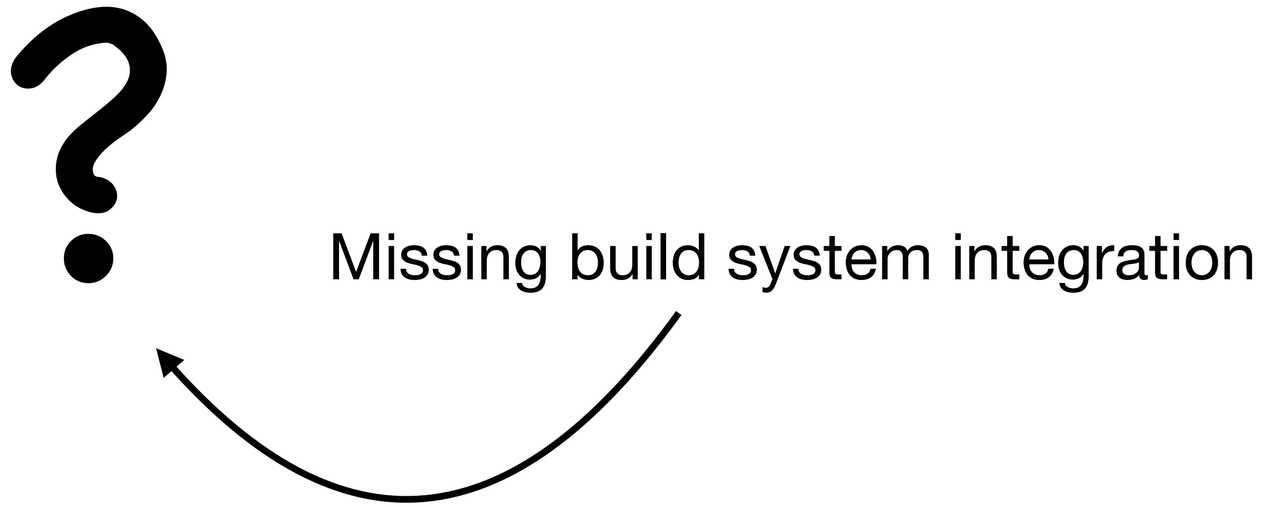
We cannot just -emit-llvm
for a real-world project

```
> clang-21 -emit-llvm -c bzip2.c

> ls *.bc
blocksort.bc  bzip2.bc   bzlib.bc  compress.bc  crctable.bc  decompress.bc  huffman.bc
randtable.bc

> lli --extra-module=blocksort.bc \
      --extra-module=bzlib.bc \
      --extra-module=compress.bc \
      --extra-module=crctable.bc \
      --extra-module=decompress.bc \
      --extra-module=huffman.bc \
      --extra-module=randtable.bc bzip2.bc --compress data.txt

> ls data.*
data.txt  data.txt.bz2
```

OrcJIT

Who is using it out there?

- Julia: https://docs.julialang.org/en/v1/devdocs/jit/
- Common Lisp: https://clasp-developers.github.io/news.html
- C / C++ / Rust / Swift / Zig:



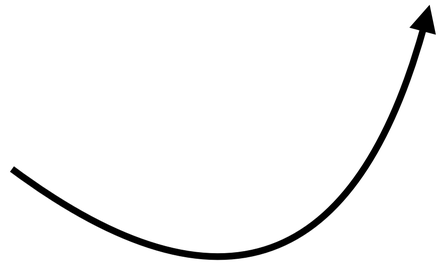
llvm-autojit plugin

Generic OrcJIT integration across LLVM compilers

llvm-autojit plugin

Generic OrcJIT integration across LLVM compilers

Repo: https://github.com/weliveindetail/llvm-autojit



llvm-autojit plugin

Generic OrcJIT integration across LLVM compilers

Idea:

- Hook into compiler pipeline early
- Cut out code and store it somewhere (e.g. on disk)
- Inject JIT loader
- Compile and link "shallow" binary as usual

llvm-autojit plugin

Building bzip2 with make

```
> make CFLAGS="-fpass-plugin=/usr/lib/llvm-21/plugins/autojit.so"
clang-21 -fpass-plugin=/usr/lib/llvm-21/plugins/autojit.so -c blocksort.c
clang-21 -fpass-plugin=/usr/lib/llvm-21/plugins/autojit.so -c huffman.c
clang-21 -fpass-plugin=/usr/lib/llvm-21/plugins/autojit.so -c crctable.c
clang-21 -fpass-plugin=/usr/lib/llvm-21/plugins/autojit.so -c randtable.c
clang-21 -fpass-plugin=/usr/lib/llvm-21/plugins/autojit.so -c compress.c
clang-21 -fpass-plugin=/usr/lib/llvm-21/plugins/autojit.so -c decompress.c
clang-21 -fpass-plugin=/usr/lib/llvm-21/plugins/autojit.so -c bzlib.c
rm -f libbz2.a
llvm-ar-21 cq libbz2.a blocksort.o huffman.o crctable.o randtable.o compress.o decompress.o bzlib.o
llvm-ranlib-21 libbz2.a
clang-21 -fpass-plugin=/usr/lib/llvm-21/plugins/autojit.so -c bzip2.c
clang-21 -O0 -g -fpass-plugin=/home/ez/Develop/llvm-project-main/build-external-llvm21/install/lib/
autojit.so -Wl,-rpath=/home/ez/Develop/llvm-project-main/build-external-llvm21/install/lib -L/home/ez/
Develop/llvm-project-main/build-external-llvm21/install/lib -lautojit-runtime -rdynamic -o bzip2 bzip2.o
-L. -Wl,--whole-archive -lbz2 -Wl,--no-whole-archive
```

llvm-autojit plugin

Works with any build system

- make
- CMake
- Cargo: requires Rust Nightly for plugin support

Find samples here:
https://github.com/weliveindetail/llvm-autojit/actions/runs/19178131679

llvm-autojit plugin

Generic OrcJIT integration across LLVM compilers

Idea:

- Hook into compiler pipeline early
- Cut out code and store it somewhere (e.g. on disk)
- Inject JIT loader
- Compile and link "shallow" binary as usual

llvm-autojit transform

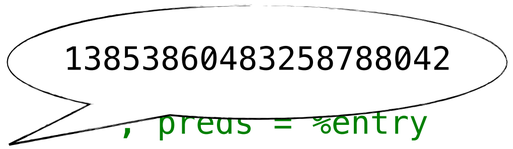
Input

```
; Function Attrs: noinline nounwind optnone uwtable
define dso_local void @BZ2_compressBlock(ptr noundef %0, i8 noundef zeroext %1) #0 !dbg !180 {
  %3 = alloca ptr, align 8
  %4 = alloca i8, align 1
  store ptr %0, ptr %3, align 8
    #dbg_declare(ptr %3, !183, !DIExpression(), !184)
  store i8 %1, ptr %4, align 1
    #dbg_declare(ptr %4, !185, !DIExpression(), !186)
  %5 = load ptr, ptr %3, align 8, !dbg !187
  %6 = getelementptr inbounds nuw %struct.EState, ptr %5, i32 0, i32 17, !dbg !189
  %7 = load i32, ptr %6, align 4, !dbg !189
  %8 = icmp sgt i32 %7, 0, !dbg !190
  br i1 %8, label %9, label %63, !dbg !190
  ...

138:                                              ; preds = %136, %112
  ret void, !dbg !311
}
```

llvm-autojit transform

Output

```
; Function Attrs: noinline nounwind optnone uwtable
define dso_local void @BZ2_compressBlock(ptr noundef %0, i8 noundef zeroext %1) #0 {
entry:
  %existing_ptr = load ptr, ptr @__llvm_autojit_ptr_BZ2_compressBlock, align 8
  %2 = icmp eq ptr %existing_ptr, null
  br i1 %2, label %materialize, label %call

materialize:                                      ; preds = %entry
  store ptr inttoptr (i64 -4592883590450763574 to ptr), ptr @__llvm_autojit_ptr_BZ2_compressBlock, align 8
  call void @__llvm_autojit_materialize(ptr @__llvm_autojit_ptr_BZ2_compressBlock)
  %materialized_ptr = load ptr, ptr @__llvm_autojit_ptr_BZ2_compressBlock, align 8
  br label %call

call:                                             ; preds = %materialize, %entry
  %impl_ptr = phi ptr [ %existing_ptr, %entry ], [ %materialized_ptr, %materialize ]
  tail call void %impl_ptr(ptr %0, i8 %1)
  ret void
}
```



llvm-autojit transform

Output

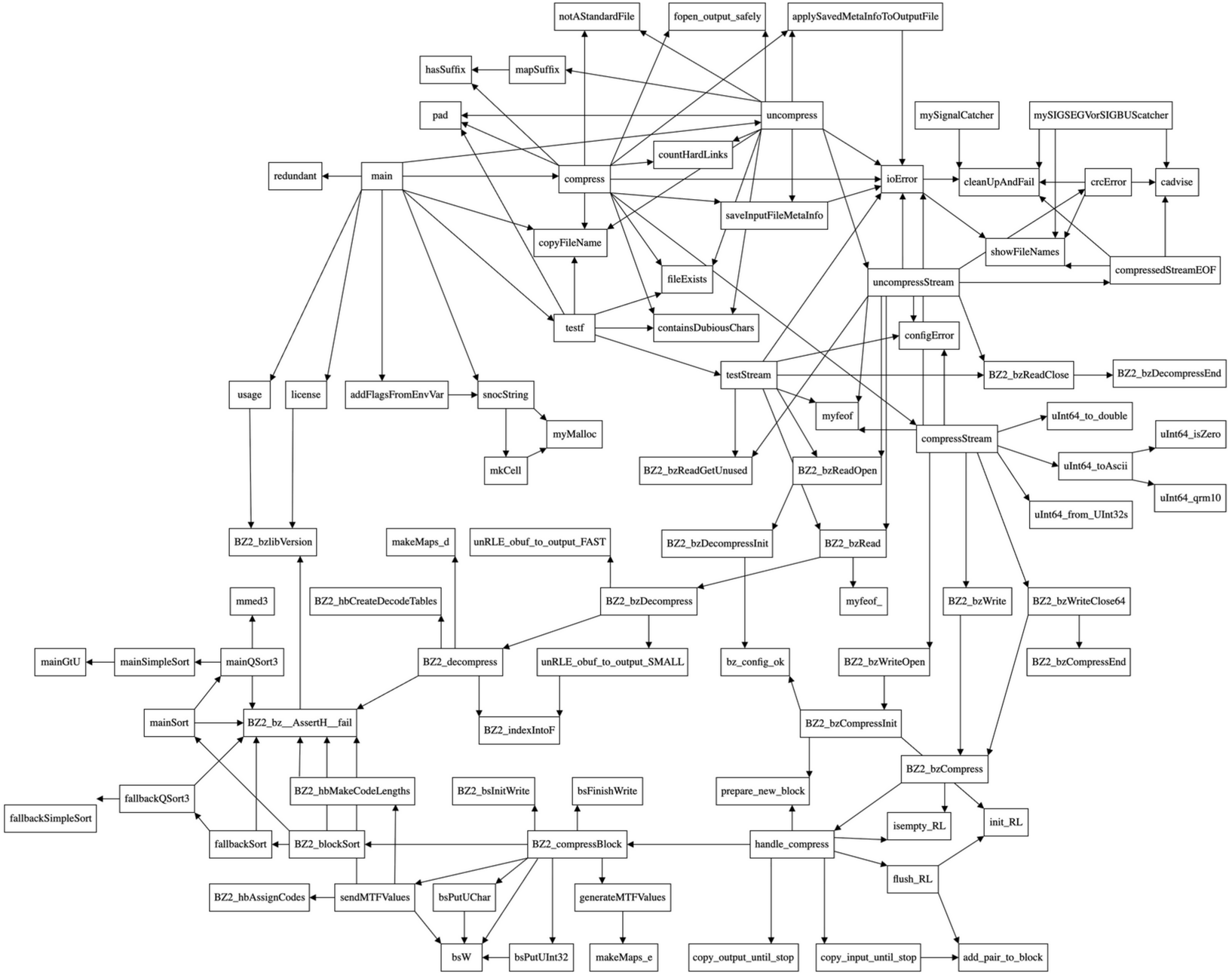
```
@__llvm_autojit_ptr_BZ2_compressBlock = internal global ptr null
@__llvm_autojit_lazy_file = private unnamed_addr constant [49 x i8] c"/tmp/autojit_4f0e030a358521399cbed216e6c35c26.bc\00"

@llvm.global_ctors = appending global [1 x { i32, ptr, ptr }] [{ i32, ptr, ptr } {
  i32 100, ptr @_GLOBAL__sub_I_compress.c_llvm_autojit_init, ptr null
}]

; Function Attrs: nounwind
define internal void @_GLOBAL__sub_I_compress.c_llvm_autojit_init() #1 section ".text.startup" {
entry:
  call void @__llvm_autojit_register(ptr @__llvm_autojit_lazy_file)
  ret void
}

declare void @__llvm_autojit_materialize(ptr)
declare void @__llvm_autojit_register(ptr)
```

llvm-autojit plugin

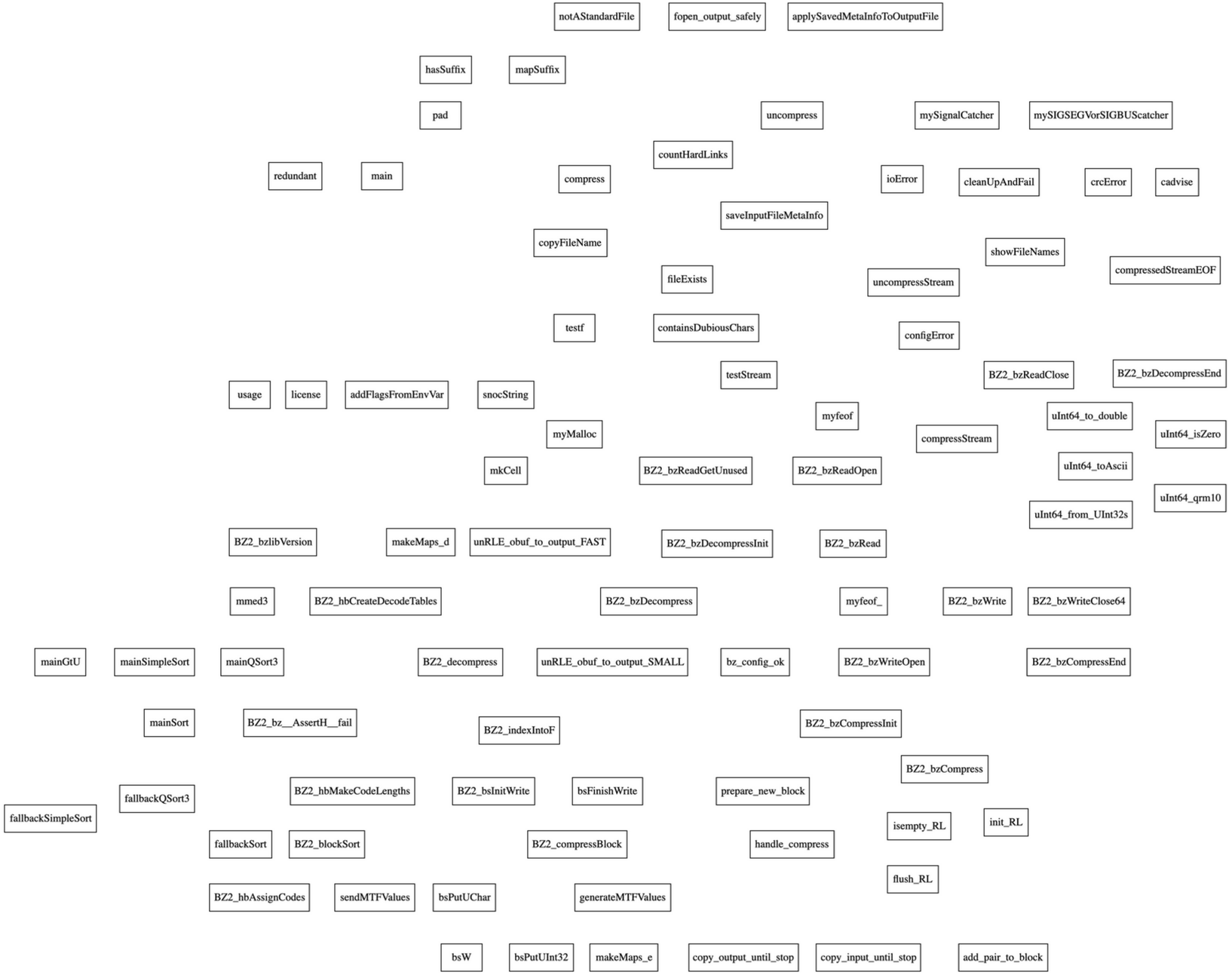
Generic OrcJIT integration across LLVM compilers

Idea:

- Hook into compiler pipeline early
- Cut out code and store it somewhere (e.g. on disk)
- Inject JIT loader
- Compile and link "shallow" binary as usual

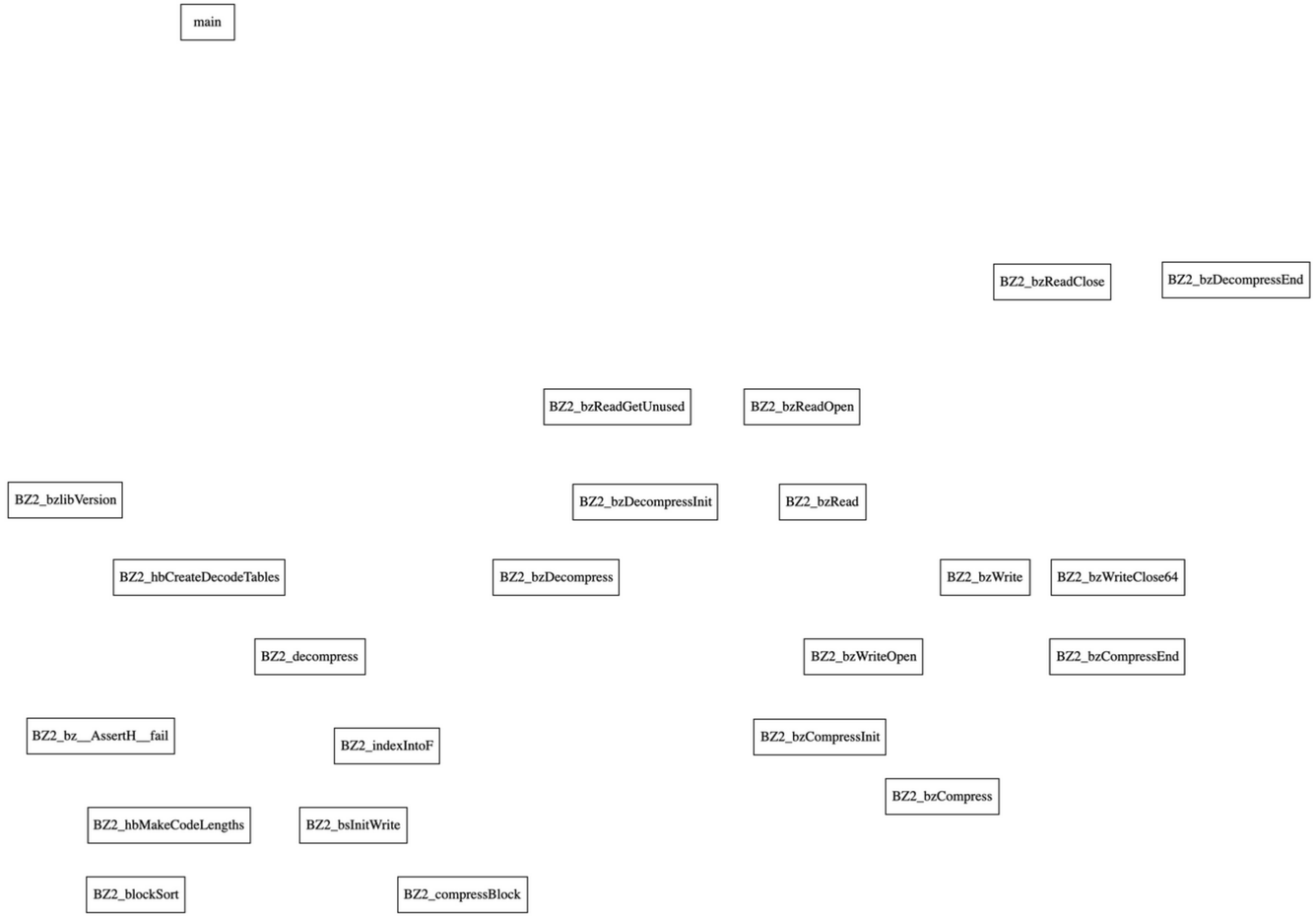


bzip2 regular callgraph



bzip2 autojit callgraph (almost)

bzip2 autojit callgraph



bzip2 binary size

```
$ ls -lh build_regular/bzip2
-rwxrwxr-x 1 ez ez 190K Nov 20 10:59 build_regular/bzip2

$ llvm-objdump -h build_regular/bzip2 > logs/bench-regular-sections.log
build_regular/bzip2:  file format elf64-x86-64

Sections:
Idx Name              Size     VMA              Type
  0                   00000000 0000000000000000
  1 .interp           0000001c 0000000000000318 DATA
  2 .note.gnu.property 00000020 0000000000000338
  3 .note.gnu.build-id 00000024 0000000000000358
  4 .note.ABI-tag     00000020 000000000000037c
  5 .gnu.hash         00000024 00000000000003a0
  6 .dynsym           00000468 00000000000003c8
  7 .dynstr           000001b1 0000000000000830
  8 .gnu.version      0000005e 00000000000009e2
  9 .gnu.version_r    00000050 0000000000000a40
 10 .rela.dyn         00000348 0000000000000a90
 11 .rela.plt         00000390 0000000000000dd8
 12 .init             0000001b 0000000000002000 TEXT
 13 .plt              00000270 0000000000002020 TEXT
 14 .plt.got          00000008 0000000000002290 TEXT
 15 .text             00014993 00000000000022a0 TEXT
 16 .fini             0000000d 0000000000016c34 TEXT
 17 .rodata           000024fa 0000000000017000 DATA
 18 .eh_frame_hdr     0000037c 00000000000194fc DATA
 19 .eh_frame         00000db0 0000000000019878 DATA
 20 .init_array       00000008 000000000001bdd0
 21 .fini_array       00000008 000000000001bdd8
 22 .dynamic          000001e0 000000000001bde0
 23 .got              00000040 000000000001bfc0 DATA
 24 .got.plt          00000148 000000000001c000 DATA
 25 .data             00000d10 000000000001c150 DATA
 26 .bss              00001130 000000000001ce60 BSS
 27 .comment          00000080 0000000000000000
 28 .debug_info       00004f55 0000000000000000 DEBUG
 29 .debug_abbrev     000009e8 0000000000000000 DEBUG
 30 .debug_line       00007e10 0000000000000000 DEBUG
 31 .debug_str        000014d7 0000000000000000 DEBUG
```

```
$ ls -lh build_autojit_shlib/bzip2
-rwxrwxr-x 1 ez ez 43K Nov 20 10:50 build_autojit_shlib/bzip2

$ llvm-objdump -h build_autojit_shlib/bzip2 > logs/bench-autojit-shlib-sections.log
build_autojit_shlib/bzip2:  file format elf64-x86-64

Sections:
Idx Name              Size     VMA              Type
  0                   00000000 0000000000000000
  1 .interp           0000001c 0000000000000318 DATA
  2 .note.gnu.property 00000020 0000000000000338
  3 .note.gnu.build-id 00000024 0000000000000358
  4 .note.ABI-tag     00000020 000000000000037c
  5 .gnu.hash         0000027c 00000000000003a0
  6 .dynsym           00000768 0000000000000620
  7 .dynstr           0000053d 0000000000000d88
  8 .gnu.version      0000009e 00000000000012c6
  9 .gnu.version_r    00000030 0000000000001368
 10 .rela.dyn         00000390 0000000000001398
 11 .rela.plt         00000030 0000000000001728
 12 .init             0000001b 0000000000002000 TEXT
 13 .plt              00000030 0000000000002020 TEXT
 14 .plt.got          00000008 0000000000002050 TEXT
 15 .text             00000fac 0000000000002060 TEXT
 16 .fini             0000000d 000000000000300c TEXT
 17 .rodata           00000201 0000000000004000 DATA
 18 .eh_frame_hdr     0000016c 0000000000004204 DATA
 19 .eh_frame         00000564 0000000000004370 DATA
 20 .init_array       00000038 0000000000005d98
 21 .fini_array       00000008 0000000000005dd0
 22 .dynamic          00000200 0000000000005dd8
 23 .got              00000028 0000000000005fd8 DATA
 24 .got.plt          00000028 0000000000006000 DATA
 25 .data             00000d10 0000000000006030 DATA
 26 .bss              00001248 0000000000006d40 BSS
 27 .comment          00000080 0000000000000000
 28 .debug_info       000012d7 0000000000000000 DEBUG
 29 .debug_abbrev     00000424 0000000000000000 DEBUG
 30 .debug_line       000003f8 0000000000000000 DEBUG
 31 .debug_str        0000065a 0000000000000000 DEBUG
```

bzip2 binary size

```
$ ls -lh build_regular/bzip2
-rwxrwxr-x 1 ez ez 190K Nov 20 10:59 build_regular/bzip2

$ llvm-objdump -h build_regular/bzip2 > logs/bench-regular-sections.log
build_regular/bzip2:  file format elf64-x86-64

Sections:
Idx Name              Size     VMA              Type
  0                   00000000 0000000000000000
  1 .interp           0000001c 0000000000000318 DATA
  2 .note.gnu.property 00000020 0000000000000338
  3 .note.gnu.build-id 00000024 0000000000000358
  4 .note.ABI-tag     00000020 000000000000037c
  5 .gnu.hash         00000024 00000000000003a0
  6 .dynsym           00000468 00000000000003c8
  7 .dynstr           000001b1 0000000000000830
  8 .gnu.version      0000005e 00000000000009e2
  9 .gnu.version_r    00000050 0000000000000a40
 10 .rela.dyn         00000348 0000000000000a90
 11 .rela.plt         00000390 0000000000000dd8
 12 .init             0000001b 0000000000002000 TEXT
 13 .plt              00000270 0000000000002020 TEXT
 14 .plt.got          00000008 0000000000002290 TEXT
 15 .text             00014993 00000000000022a0 TEXT
 16 .fini             0000000d 0000000000016c34 TEXT
 17 .rodata           000024fa 0000000000017000 DATA
 18 .eh_frame_hdr     0000037c 00000000000194fc DATA
 19 .eh_frame         00000db0 0000000000019878 DATA
 20 .init_array       00000008 000000000001bdd0
 21 .fini_array       00000008 000000000001bdd8
 22 .dynamic          000001e0 000000000001bde0
 23 .got              00000040 000000000001bfc0 DATA
 24 .got.plt          00000148 000000000001c000 DATA
 25 .data             00000d10 000000000001c150 DATA
 26 .bss              00001130 000000000001ce60 BSS
 27 .comment          00000080 0000000000000000
 28 .debug_info       00004f55 0000000000000000 DEBUG
 29 .debug_abbrev     000009e8 0000000000000000 DEBUG
 30 .debug_line       00007e10 0000000000000000 DEBUG
 31 .debug_str        000014d7 0000000000000000 DEBUG
```

```
$ ls -lh build_autojit_shlib/bzip2
-rwxrwxr-x 1 ez ez 43K Nov 20 10:50 build_autojit_shlib/bzip2

$ llvm-objdump -h build_autojit_shlib/bzip2 > logs/bench-autojit-shlib-sections.log
build_autojit_shlib/bzip2:  file format elf64-x86-64

Sections:
Idx Name              Size     VMA              Type
  0                   00000000 0000000000000000
  1 .interp           0000001c 0000000000000318 DATA
  2 .note.gnu.property 00000020 0000000000000338
  3 .note.gnu.build-id 00000024 0000000000000358
  4 .note.ABI-tag     00000020 000000000000037c
  5 .gnu.hash         0000027c 00000000000003a0
  6 .dynsym           00000768 0000000000000620
  7 .dynstr           0000053d 0000000000000d88
  8 .gnu.version      0000009e 00000000000012c6
  9 .gnu.version_r    00000030 0000000000001368
 10 .rela.dyn         00000390 0000000000001398
 11 .rela.plt         00000030 0000000000001728
 12 .init             0000001b 0000000000002000 TEXT
 13 .plt              00000030 0000000000002020 TEXT
 14 .plt.got          00000008 0000000000002050 TEXT
 15 .text             00000fac 0000000000002060 TEXT
 16 .fini             0000000d 000000000000300c TEXT
 17 .rodata           00000201 0000000000004000 DATA
 18 .eh_frame_hdr     0000016c 0000000000004204 DATA
 19 .eh_frame         00000564 0000000000004370 DATA
 20 .init_array       00000038 0000000000005d98
 21 .fini_array       00000008 0000000000005dd0
 22 .dynamic          00000200 0000000000005dd8
 23 .got              00000028 0000000000005fd8 DATA
 24 .got.plt          00000028 0000000000006000 DATA
 25 .data             00000d10 0000000000006030 DATA
 26 .bss              00001248 0000000000006d40 BSS
 27 .comment          00000080 0000000000000000
 28 .debug_info       000012d7 0000000000000000 DEBUG
 29 .debug_abbrev     00000424 0000000000000000 DEBUG
 30 .debug_line       000003f8 0000000000000000 DEBUG
 31 .debug_str        0000065a 0000000000000000 DEBUG
```

bzip2 data section

```
Idx Name              Size     VMA              Type
  0                   00000000 0000000000000000
  1 .interp           0000001c 0000000000000318 DATA
  2 .note.gnu.property 00000020 0000000000000338
  3 .note.gnu.build-id 00000024 0000000000000358
  4 .note.ABI-tag     00000020 000000000000037c
  5 .gnu.hash         00000024 00000000000003a0
  6 .dynsym           00000468 00000000000003c8
  7 .dynstr           000001b1 0000000000000830
  8 .gnu.version      0000005e 00000000000009e2
  9 .gnu.version_r    00000050 0000000000000a40
 10 .rela.dyn         00000348 0000000000000a90
 11 .rela.plt         00000390 0000000000000dd8
 12 .init             0000001b 0000000000002000 TEXT
 13 .plt              00000270 0000000000002020 TEXT
 14 .plt.got          00000008 0000000000002290 TEXT
 15 .text             00014993 00000000000022a0 TEXT
 16 .fini             0000000d 0000000000016c34 TEXT
 17 .rodata           000024fa 0000000000017000 DATA
 18 .eh_frame_hdr     0000037c 00000000000194fc DATA
 19 .eh_frame         00000db0 0000000000019878 DATA
 20 .init_array       00000008 000000000001bdd0
 21 .fini_array       00000008 000000000001bdd8
 22 .dynamic          000001e0 000000000001bde0
 23 .got              00000040 000000000001bfc0 DATA
 24 .got.plt          00000148 000000000001c000 DATA
 25 .data             00000d10 000000000001c150 DATA
 26 .bss              00001130 000000000001ce60 BSS
 27 .comment          00000080 0000000000000000
 28 .debug_info       00004f55 0000000000000000 DEBUG
 29 .debug_abbrev     000009e8 0000000000000000 DEBUG
 30 .debug_line       00007e10 0000000000000000 DEBUG
 31 .debug_str        000014d7 0000000000000000 DEBUG
 32 .debug_addr       00000ca0 0000000000000000 DEBUG
 33 .debug_line_str   00000181 0000000000000000 DEBUG
 34 .debug_rnglists   0000001b 0000000000000000 DEBUG
 35 .debug_str_offsets 00001028 0000000000000000 DEBUG
 36 .symtab           00001470 0000000000000000
 37 .strtab           00000c2c 0000000000000000
 38 .shstrtab         0000018a 0000000000000000
```

```
Idx Name              Size     VMA              Type
  0                   00000000 0000000000000000
  1 .interp           0000001c 0000000000000318 DATA
  2 .note.gnu.property 00000020 0000000000000338
  3 .note.gnu.build-id 00000024 0000000000000358
  4 .note.ABI-tag     00000020 000000000000037c
  5 .gnu.hash         0000027c 00000000000003a0
  6 .dynsym           00000768 0000000000000620
  7 .dynstr           0000053d 0000000000000d88
  8 .gnu.version      0000009e 00000000000012c6
  9 .gnu.version_r    00000030 0000000000001368
 10 .rela.dyn         00000390 0000000000001398
 11 .rela.plt         00000030 0000000000001728
 12 .init             0000001b 0000000000002000 TEXT
 13 .plt              00000030 0000000000002020 TEXT
 14 .plt.got          00000008 0000000000002050 TEXT
 15 .text             00000fac 0000000000002060 TEXT
 16 .fini             0000000d 000000000000300c TEXT
 17 .rodata           00000201 0000000000004000 DATA
 18 .eh_frame_hdr     0000016c 0000000000004204 DATA
 19 .eh_frame         00000564 0000000000004370 DATA
 20 .init_array       00000038 0000000000005d98
 21 .fini_array       00000008 0000000000005dd0
 22 .dynamic          00000200 0000000000005dd8
 23 .got              00000028 0000000000005fd8 DATA
 24 .got.plt          00000028 0000000000006000 DATA
 25 .data             00000d10 0000000000006030 DATA
 26 .bss              00001248 0000000000006d40 BSS
 27 .comment          00000080 0000000000000000
 28 .debug_info       000012d7 0000000000000000 DEBUG
 29 .debug_abbrev     00000424 0000000000000000 DEBUG
 30 .debug_line       000003f8 0000000000000000 DEBUG
 31 .debug_str        0000065a 0000000000000000 DEBUG
 32 .debug_addr       00000198 0000000000000000 DEBUG
 33 .debug_line_str   0000017f 0000000000000000 DEBUG
 34 .debug_str_offsets 00000484 0000000000000000 DEBUG
 35 .symtab           00000de0 0000000000000000
 36 .strtab           000009fa 0000000000000000
 37 .shstrtab         0000017a 0000000000000000
```

OrcJIT

Loads all code on startup

Before entering `main()`
we have to...

- Parse all symbol names
- Allocate global variables
- Initialize global variables

llvm-autojit plugin

A novel approach for OrcJIT at scale

- Generic plugin for LLVM-based compilers and all build systems
- Cut out IR code at compile-time while keeping ABI intact
  - ✓ Reduce binary size and compile-time
  - ✓ Incremental builds avoid relink, as long as we don't touch ABI
  - ✓ Mix autojit objects with regular ones
- Global variables remain in static executable
  - ✓ Achieve true lazy loading
  - ✓ Support link-once symbols efficiently

llvm-autojit plugin

Generic OrcJIT integration across LLVM compilers

https://github.com/weliveindetail/llvm-autojit