The LLVM compiler framework

Writing a pass: Quick Start

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2020-04-17

These slides were originally written by Stefano Cherubin for the "Code Transformation and Optimization" course.

Contents

Understanding LLVM

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LLVM is a collection of components
which is useful to build a compiler.

Getting LLVM

- “old” git mirrors
  - only llvm repo (subprojects in separated repos, can be added later)
  - `git clone -b release_80 --single-branch git@github.com:llvm-mirror/llvm.git`

- “new” git monorepo
  - all in one repo (llvm + major subprojects)
  - `git clone -b release/8.x --single-branch git@github.com:llvm/llvm-project.git`

What LLVM is made of

- C++ libraries
  - `src/include/llvm/...`
  - `src/lib/...`

- small application (tools)
  - `src/tools/...`
  - `src/utils/...`

You can find binaries of them in the installation directory under `root/bin/...`

clang

- `clang` is a compiler based on LLVM
- It compiles all major C-like languages

- It is part of the git monorepo
- It can be added as a tool in the LLVM framework but must be manually cloned in the tool directory
  1. `cd src/tools`
  2. `git clone http://llvm.org/git/clang` (git mirror version)

- You can easily see on a production quality compiler the impact of changes you made on your local copy of LLVM

Contents

Commands

llvm-as	LLVM assembler
llvm-dis	LLVM disassembler
opt	LLVM optimizer
llc	LLVM static compiler
lli	directly execute programs from LLVM bitcode
llvm-link	LLVM bitcode linker
llvm-mca	LLVM machine code analyzer
llvm-nm	list LLVM bitcode and object file's symbol table
llvm-stress	generate random .ll files
llvm-config	prints out install configuration parameters
llvm-dwarfdump	print contents of DWARF sections

For a complete reference, see LLVM command guide *

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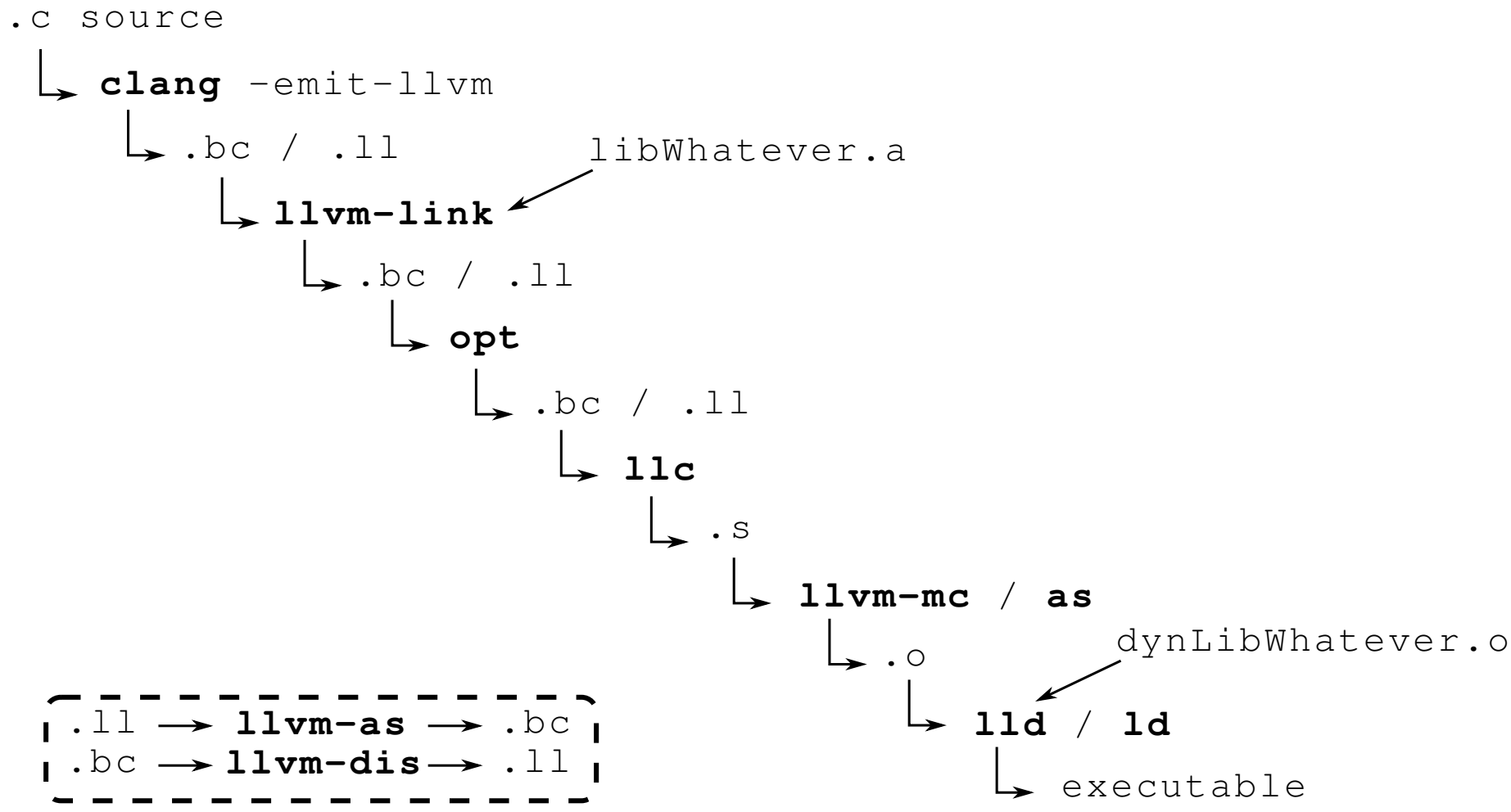
*http://llvm.org/docs/CommandGuide/index.html


.c source
clang -emit-llvm
.bc / .ll
libWhatever.a
llvm-link
.bc / .ll
opt
.bc / .ll
llc
.s
llvm-mc / as
.o
dynLibWhatever.o
lld / ld
executable
.ll → llvm-as → .bc
.bc → llvm-dis → .ll

Writing a LLVM pass

There are a lot of tutorials available:

- Official developer guide
  `llvm.org/docs/WritingAnLLVMPass`

- Out-of-source pass
  `github.com/quarkslab/`
  `llvm-dev-meeting-tutorial-2015`

We will follow the first one, with a few adjustments.

Testing

LLVM has an internal testing infrastructure. * Please use it.

llvm-lit LLVM Integrated Tester

1. Forge a proper LLVM-IR input file (.ll) for your test case
2. Instrument it with `lit` script comments
3. Run `lit` on your test
   - `llvm-lit /llvm/test/myTests/singleTest.ll`
     run a single test
   - `llvm-lit /llvm/test/myTests`
     run the test suite (folder)
4. Run `lit` on the LLVM test suite (regression testing)

To submit a bug report to LLVM developers you will be asked to write a `lit` test case that highlights the bug.

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*`http://llvm.org/docs/TestingGuide.html`