An LLVM back end for sourir

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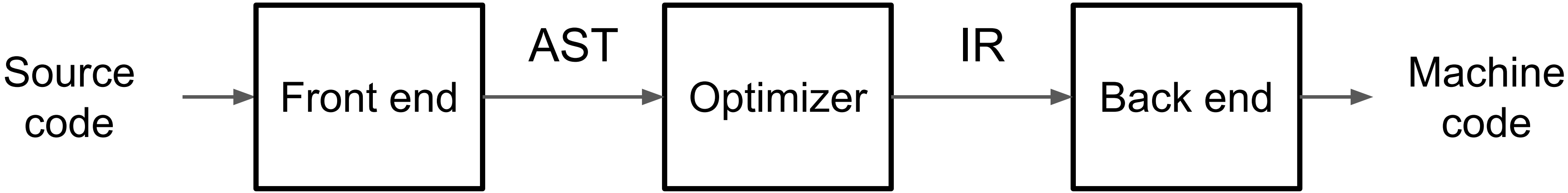
Outline

1. Compiler introduction
2. What is sourir and why?
3. Quick dive into LLVM
4. Sourir architecture
5. Demo
6. Conclusion
7. Future work

Traditional Compiler



- Modern compilers: multiple passes in optimizer

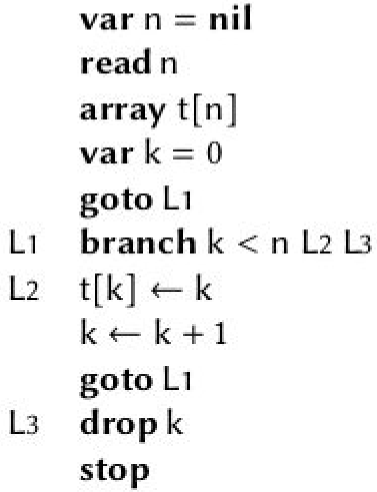
To be continued...

Sourir

Low-level programing language or
High-level intermediate representation

- Primitive datatypes, no Classes, Objects
- Program flow using labels, goto and branch
- Consists of functions

- Functions can have **version**’s
- **assume** instruction



```
     var n = nil
     read n
     array t[n]
     var k = 0
     goto L1
L1   branch k < n L2 L3
L2   t[k] ← k
     k ← k + 1
     goto L1
L3   drop k
     stop
```

Dynamic programming languages

At runtime:

- Loading of new code
- Extension of objects and definitions
- Often dynamically typed

- Use just-in-time (JIT) compiler
  → continuously iterate and dump code at latest possible time
- Optimize code based on speculations (assume types etc.)

Eg. Javascript, Smalltalk, PHP, Python

Sourir

- Designed as IR for dynamic languages
- Explicit versions of functions
- Explicit assumptions
  → Easier to reason about optimizations / deoptimizations

- out of the scope for today

LLVM

Originally: **Low Level Virtual Machine**
Today: “collection of modular and reusable compiler and toolchain technologies"

- Written for C, C++ but with language-agnostic design
- Front ends: D, Fortran, Objective-C, Python, R, Rust, …
- Back ends: x86, x86-64, PowerPC, MIPS, ARM, AMD GCN, …
- Linker, machine code translator, C++ standard library, Debugger, …
- LLVM IR
- Optimization using passes
- Offers a JIT

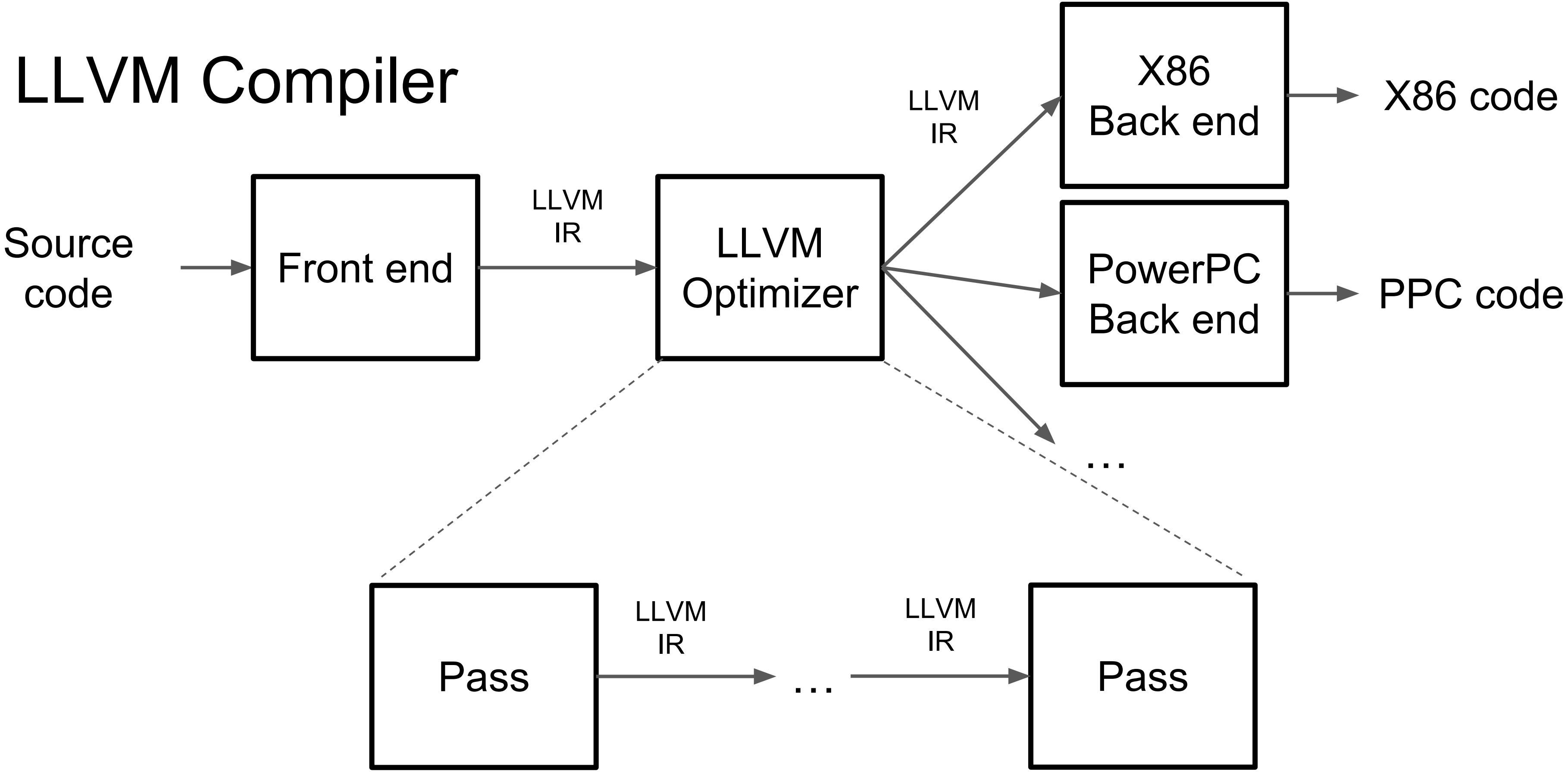
LLVM IR

- Heart of LLVM
- Strongly typed RISC instruction set
- Infinite set of registers
- Static single assignment (SSA) form

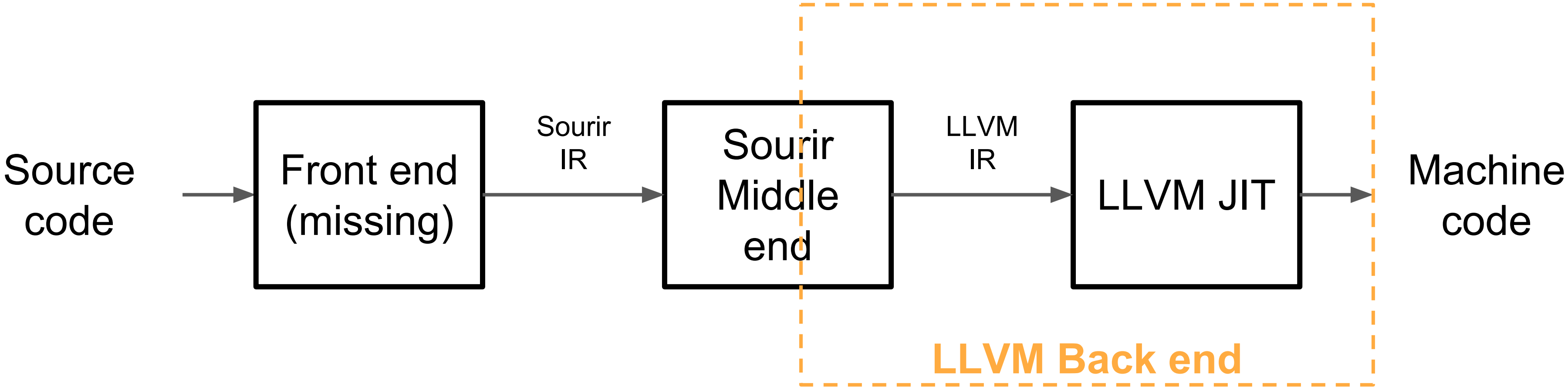
Three equivalent forms:

- C++ object format
- Plain text (assembly)
- bitcode

LLVM Compiler



Sourir JIT


Source code
Front end (missing)
Sourir IR
Sourir Middle end
LLVM IR
LLVM JIT
Machine code
LLVM Back end

Demo

Conclusion

LLVM

- handy and fast
- But: “official” support doesn’t mean good documentation

Ocaml

- Function programming is fun
- But: irritating syntax
- Inconvenient setup

Future work

- Basic features left: arrays, print/read, drop, booleans
- Advanced: version, assume
- Optimization as LLVM passes
- Front end for high level language