PGI® COMPILERS &TOOLS

Flang Update

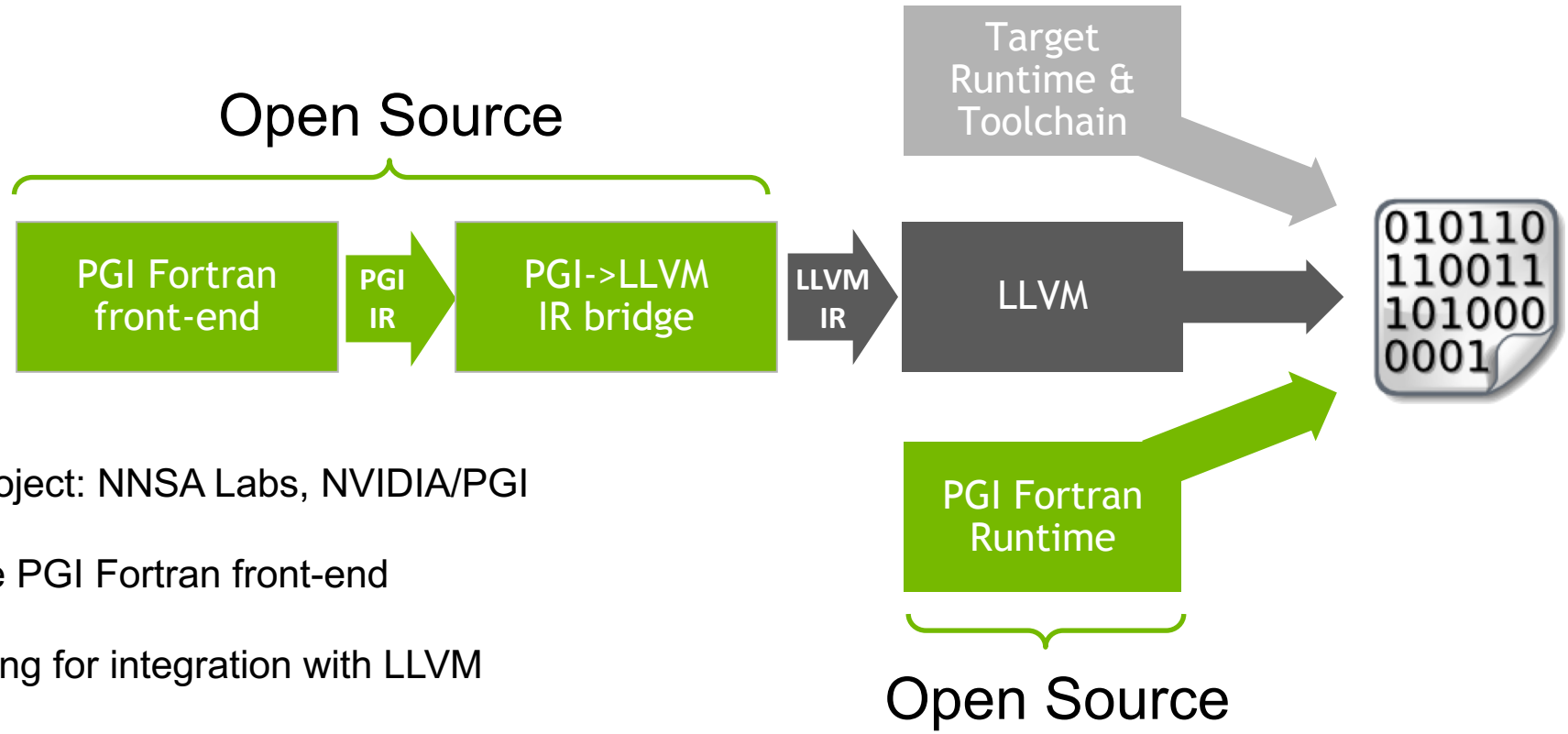
2018 European LLVM Developers' Meeting

17 April, 2018

NVIDIA

THE FLANG PROJECT

An open source Fortran front-end for LLVM



Multi-year project: NNSA Labs, NVIDIA/PGI

Based on the PGI Fortran front-end

Re-engineering for integration with LLVM

Develop CLANG-quality Fortran front end

STATE OF THE PROJECT

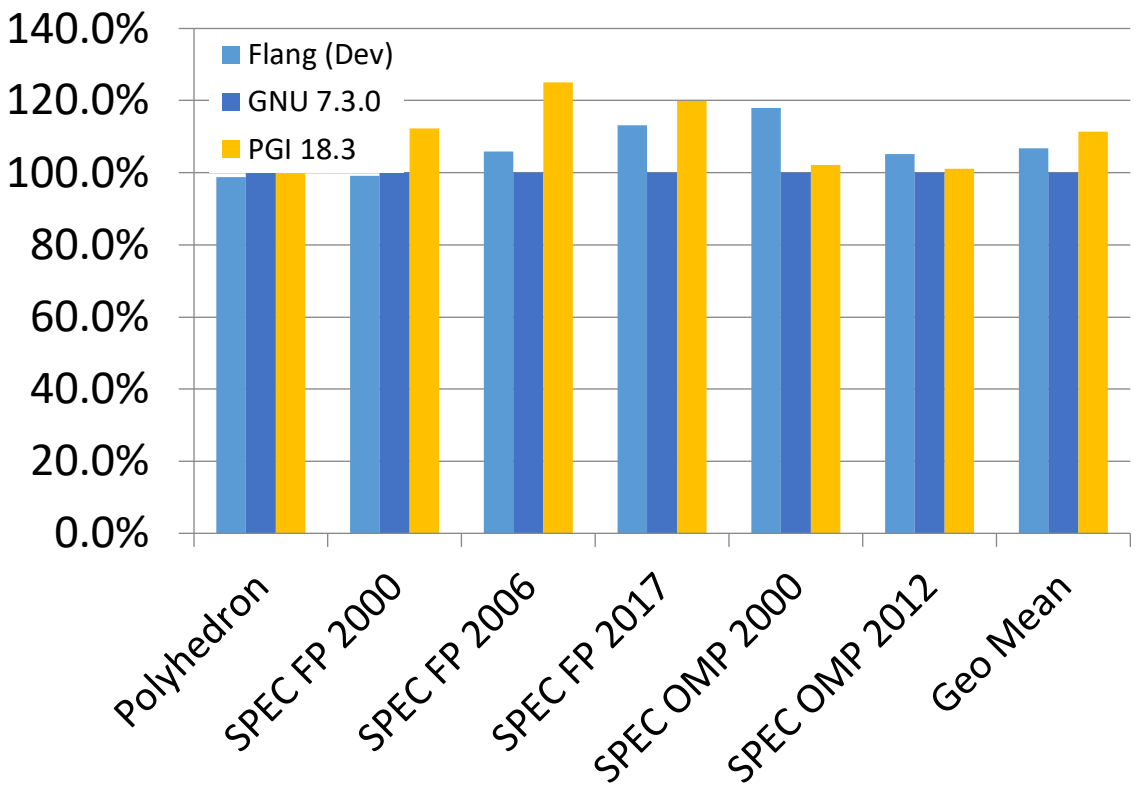
- Source code released in May, 2017
- NVIDIA continually updates source to match PGI front-end
- First CLAs have been received; several submission queued
- Github, slack, mailing list in place; github issues are active
- Roadmap, submission policies, documentation published on github
- https://github.com/flang-compiler/flang

FLANG NUMERICAL INTRINSICS LIBRARY

- Compiler-callable math intrinsics library (*libpgmath*) designed to underlie the numerical intrinsics in Fortran, C and C++
- Designed to augment *libm* with fast and relaxed implementations
- Scalar and SIMD versions of elemental functions (sin, cos, …)
- Current implementations for X86-64 and POWER CPUs
- Mostly written in C; possible to tune with assembly code when needed
- Open-sourced in March 2018 as part of Flang in github.com/flang-compiler/flang

FLANG SINGLE-CORE PERFORMANCE

All runs on Intel Xeon Skylake



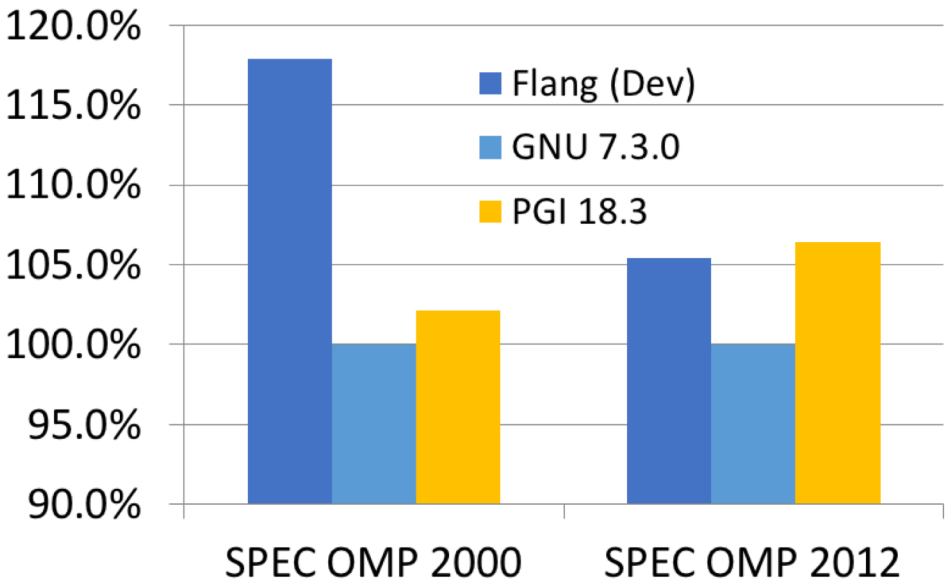
SPEC FP RATE 2017 Application	Flang (Dev) secs	PGI 18.3 secs	GNU 7.3.0 secs
503.bwaves	338.5	294.3	313.7
507.cactuBSSN	257.8	255.9	257.8
521.wrf	334.1	294.0	487.6
527.cam	357.1	333.9	372.0
549.fotonik3d	373.0	363.4	413.5
554.roms	227.4	231.7	304.7
Geo Mean	**309.7**	**292.2**	**350.3**

Flang Dev: -O2 -ffast-math -march=native
GNU: -O3 -ffast-math -fpeel-loops -funroll-loops
PGI 18.3: -fast -Bstatic_pgi -Mfprelaxed -Mhugetlb -Mnouniform -Mstack_arrays

Performance measured March, 2018 and are considered ESTIMATES per SPEC run and reporting rules. Two 20 core Skylake Intel® Gold 6148 CPU @ 2.40GHz w/ 256GB memory. SPEC® is a registered trademark of the Standard Performance Evaluation Corporation (www.spec.org).

FLANG OPENMP 3.1 PERFORMANCE

All runs on dual-socket Intel Xeon Skylake



SPEC OMP 2012 Application	Flang (Dev) secs	PGI 18.3 secs	GNU 7.3.0 secs
350.md	226.8	246.4	352.0
351.bwaves	261.4	249.1	253.8
357.bt331	287.3	267.0	306.2
360.ilbdc	308.6	328.6	321.3
362.fma3d	337.1	304.2	304.2
363.swim	324.0	326.4	322.7
370.mgrid331	354.4	352.4	350.7
371.applu331	244.1	244.9	250.2
Geo Mean	**289.7**	**287.1**	**305.4**

Flang Dev: -O2 -ffast-math -march=native -mp
GNU: -O3 -ffast-math -fpeel-loops -funroll-loops -fopen-mp
PGI 18.3: -fast -Bstatic_pgi -Mfprelaxed -Mhugetlb -Mnouniform -Mstack_arrays -mp

Performance measured March, 2018 and are considered ESTIMATES per SPEC run and reporting rules.
Two 20 core Skylake Intel® Gold 6148 CPU @ 2.40GHz CPUs @ 2.4GHz w/ 256GB memory. SPEC® is a registered trademark of the Standard Performance Evaluation Corporation (www.spec.org).

PGI

FEEDBACK – SOURCE CODE, DATA STRUCTURES

- LALR Parser has no hooks for tools
- C program; monolithic without structured libraries
- Written in C, not C++; makes code sharing and reuse difficult
- Driver uses obscure –x flags instead of flags with meaningful names
- Error messages do not convey much context or detail compared to Clang
- AST lowered early; not suitable for source-to-source translation
- LLVM IR is generated using printf, not IRBuilder classes

RESPONDING TO FEEDBACK

- Refactor the pre-processor, scanner, and parser in C++
  - High-quality source locations
  - ATSs as C++ classes with tooling in mind
  - ASTs follow the Fortran standard very closely
- Restructure to improve support for tools
  - Defer lowering until the AST is complete and checked
  - Organize as libraries; expose support routines
- Convert flang2 to C++ to accommodate IRBuilder

https://github.com/flang-compiler/flang