Fortran@50
Application / User Viewpoint

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Impact

- Hard to understate the impact Fortran has had on application development.

- Though it was intended primarily for programming scientific and mathematical applications its reach extends far beyond that into industry, HPC, parallel computing.

- At NCAR, all of our production applications are written in Fortran (~80% F90, 20% F95).

- Story is similar at the universities.

- Though there is a bit more variety at the other national laboratories and in industry, Fortran remains a important component of their application development programs.
Lore is that if you want performance you use Fortran.

Though the gap has narrowed between what the compilers deliver for “well-written” Fortran and C code, Fortran still holds the edge.

To circumvent expressiveness concerns, many have very successful formula:

- Fortran for the computational kernels.
- C for the bookkeeping.

Extremely successful for F77/C, less so for other combinations.

Cursory survey of the Gordon Bell winning applications indicates that virtually all of them relied on Fortran in some capacity.
NEK5000 – 1999 Gordon Bell Winner

- Incompressible Navier-Stokes (unsteady).
- Spectral Element Method (high-order).
- Ideal for 3D transitional and weakly turbulent flows.
- Axisymmetric, 2D, and 3D flow configurations.
- Multiple-species transport.
- Supports a broad range of boundary conditions.
- Handles complex geometries.
- 376 GF on 4096 Processors of ASCI Red (30% peak).
- Scalable coarse grid solver.

Transitional boundary layers

Deep atmosphere convection dynamics

Rayleigh-Taylor instability (mixing)

Paul Fischer and Henry Tufo
Astrophysical thermonuclear explosions.
Euler (PPM), realistic EOS, nuclear reaction network, gravity, radiation transport, etc.
Wide range of compressibility.
Wide range of length and time scales.
Fairly simple geometries.
238 GF on 6420 Processors of ASCI Red (11% peak).

Rosner, Fryxell, Dursi, Zingale, Olson, Calder, Ricker, Tufo
Concerns I

- Training, or lack thereof, is a significant challenge.

- The bulk of the active application developers are as old as the language.

- Folks just starting out typically have no knowledge of Fortran so we have to train them ourselves.

- CS departments don’t even know what Fortran is, much less offer courses on it.

- Fear is that over time Fortran will become a dead language (e.g., like Latin, used only for high mass).
Concerns II

- The Fortran standard continues to evolve.

- Fortran 90, 95, 2003, and 2008 … make Fortran more and more C/C++ like.

- The added complexity makes the compiler’s job much more difficult and often results in reduced performance.

- Add the previous concern, lack of adequate training, and the situation becomes much worse.

- Fear is that in joining the “modern” languages, Fortran will lose its identity and therefore many of its attractive features (e.g., performance).
Training, though problematic, is becoming more organized and, with the advent of computational science programs, hopefully will find a home in the (near) future.

Concerns regarding the evolution of Fortran are well founded but as long as one restricts his/her passions, high levels of performance are still achievable.

Fifty years has created a tremendous code legacy that will be hard to erase.
Most Frequent Response

And it’ll be around for another fifty.