Session 11: Code Development within the FUN3D Framework

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Is There a Better Way to Develop Software?

- Development of Langley CFD solvers has traditionally been a 1- or 2-person operation
- Lacked a rigorous testing environment
- Standardization and portability often overlooked
- Version control became a nightmare
- Low-level collaboration within LaRC very difficult; off-site collaborations virtually impossible
- Amount of source code and expertise needed for today's advanced algorithms quickly becomes unwieldy

Modern Software Development Practices

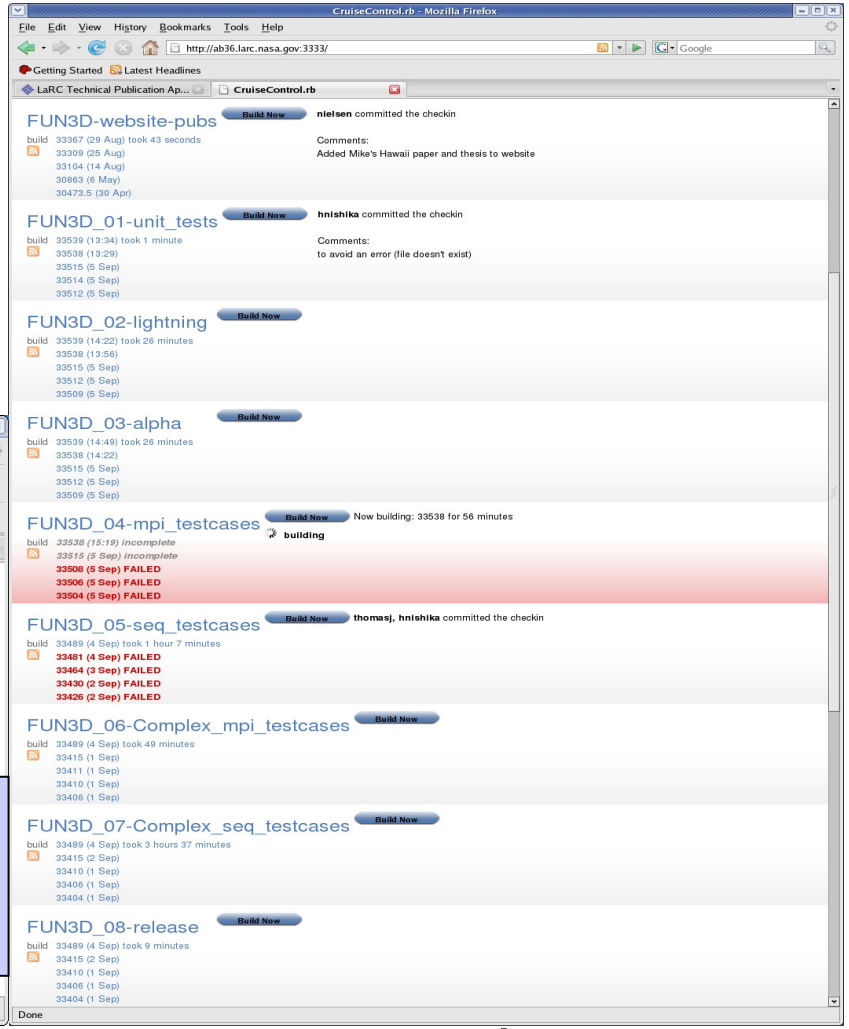
- Formal version control using Subversion; repository sits outside LaRC firewall
- Enables anyone anywhere to work directly on our source code in real-time
  - Frequent commits encouraged (~1 hour or less; real-time view on website)
  - Integrates all capabilities in one centralized suite
  - User support vastly easier
- Documented coding standard ensures uniformity, portability
  - Pre-commit script checks for adherence, rejects sloppy code
  - Enables automated scripting of templates, other extensive source code manipulations
- Hundreds of tests performed continuously around-the-clock on wide range of compilers/hardware: x86/Sun/SGI/DEC/Mac/Opteron/HP/etc
  - Failures reported to team members immediately via email, SMS
  - Bugs confined to a few lines of code and identified within an hour, rather than thousands of lines developed over months
  - Compiler bugs identified routinely

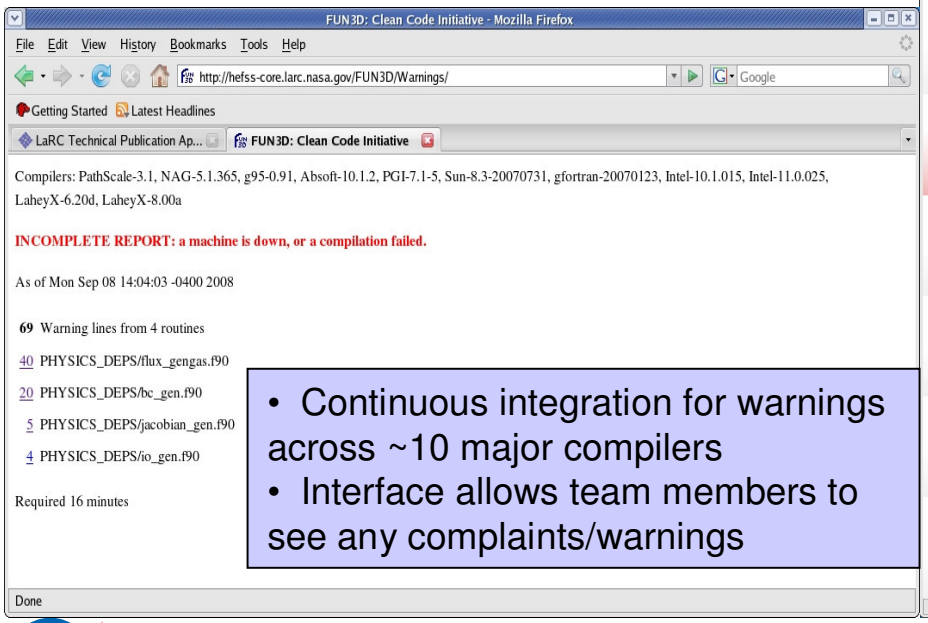
Modern Software Development Practices

- Weekly scrums foster collaboration and communication
  - Management/observers encouraged to attend, but only workers allowed to talk
  - One at a time, each member reports “did – doing – will do – in the way”
  - Scrum master notes impediments to progress, strives to remove them
  - Goal is to be done in 15 minutes
  - No “Death by PowerPoint”
- Additional discussion via mailing list, wiki
- Website also kept under Subversion, maintained collectively by entire team
  - Automatically generated and placed on server whenever text files in repository are updated
  - Team members need not know fancy HTML to contribute
- Unit testing slowly becoming more prevalent
  - Tough to retrofit legacy code
  - Released “FUnit”, framework for unit testing Fortran code at *http://nasarb.rubyforge.org/*
- Pair-programming practiced regularly

Compiler Gauntlet and Build Dashboard

- Hierarchy of cascading continuous builds keeps close tabs on code status
- Failures reported to team members via E-mail/SMS
- Bugs typically found/corrected in minutes
- Interactive GUI allows access to current and archived build information
- If a revision passes the entire hierarchy, it is tarred up, ready for external release
- Website also built continuously





- Continuous integration for warnings across ~10 major compilers
- Interface allows team members to see any complaints/warnings

FUN3D Development Widespread Developers work on central source code in real-time

Advanced Engineering Environments Branch
- Dana Hammond - HPC, computer science
- Bill Jones - geometry, gridding, adaptation

Aerothermodynamics Branch
- Karen Bibb – high-energy applications
- Peter Gnoffo - high-energy algorithms
- Bil Kleb - software practices, applications

Computational AeroSciences Branch
- Bob Biedron - dynamic simulations
- Jan-Renee Carlson – turbulence, jet flows, bc's
- Mark Carpenter - solvers
- Beth Lee-Rausch - applications
- Eric Nielsen - solvers, adjoints, design
- Mike Park - cut-cells, adaptation
- Chris Rumsey - turbulence
- Jim Thomas - solvers, discretizations
- Veer Vatsa - applications
- Jeff White - hypersonics

Flow Physics and Control Branch
- P. Balakumar - turbulence

NASA Glenn

National Institute of Aerospace

Academia
- Georgia Tech
- MIT
- NC A&T
- Penn State
- U. of Tennessee-Chattanooga
- U. of Wyoming

OGA
- US Army/AMRDEC-Huntsville
- Argonne, Oak Ridge National Labs

Industry

Visitors/Students

Very broad mix of theoretical, development, and applied personnel:
- *Fundamental research*
- *Real-world applications*