Code Coverage Demo and CI Demo

Presented at

Better Scientific Software tutorial

SC17, Denver, Colorado

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License, citation and acknowledgements

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Code Coverage

How do we determine what other tests are needed?

- Code coverage tools
  - Expose parts of the code that aren't being tested
  - gcov
    - standard utility with the GNU compiler collection suite
    - counts the number of times each statement is executed
  - lcov
    - a graphical front-end for gcov
    - available at http://ltp.sourceforge.net/coverage/lcov.php

How to use gcov/lcov

- Compile and link your code with --coverage flag
  - It's a good idea to disable optimization
- Run your test suite
- Collect coverage data using gcov/lcov
- Optional: generate html output using genhtml

A hands-on gcov tutorial

- https://amklinv.github.io/morpheus/index.html

But I don't use C++!

- gcov also works for C and Fortran
- Other tools exist for other languages
  - JCov for Java
  - Coverage.py for python
  - Devel::Cover for perl
  - profile for MATLAB
  - etc

Continuous integration

Continuous integration (CI): a master branch that always works

- Code changes trigger automated builds/tests on target platforms
- Builds/tests finish *in a reasonable amount of time*, providing useful feedback when it's most needed
- Immensely helpful!
- Requires some work, though:
  - A reasonably automated build system
  - An automated test system with significant test coverage
  - A set of systems on which tests will be run, and a controller

Continuous integration (CI): a master branch that always works

- Has existed for some time
- Adoption has been slow
  - Setting up and maintaining CI systems is difficult, labor-intensive (typically requires a dedicated staff member)
  - *You have to be doing a lot of things right to even consider CI*

Cloud-based CI is available as a service on GitHub

- Automated builds/tests can be triggered via pull requests
- Builds/tests can be run on cloud systems – no server in your closet. *Great use of the cloud!*
- Test results are reported on the pull request page (with links to detailed logs)
- Already being used successfully by scientific computing projects, with noticeable benefits to productivity
- Not perfect, but *far* better than not doing CI

Travis CI is a great choice for HPC

- Integrates easily with GitHub
- *Free* for Open Source projects
- Supports environments with C/C++/Fortran compilers (GNU, Clang, Intel[?])
- Linux, Mac platforms available
- *Relatively* simple, *reasonably* flexible configuration file
  - Documentation is sparse, but we now have working examples

Travis CI live demo

- https://github.com/amklinv/morpheus

Other resources

Software testing levels and definitions:
http://www.tutorialspoint.com/software_testing/software_testing_levels.htm

Working Effectively with Legacy Code, Michael Feathers. The legacy software change algorithm described in this book is very straight-forward and powerful for anyone working on a code that has insufficient testing.

Code Complete, Steve McConnell. Excellent testing advice. His description of Structure Basis Testing is good, and it is a simple concept: Write one test for each logic path through your code.

Organization dedicated to software testing: https://www.associationforsoftwaretesting.org/

Software Carpentry: http://katyhuff.github.io/python-testing/

Tutorial from Udacity: https://www.udacity.com/course/software-testing--cs258

Papers on testing:
http://www.sciencedirect.com/science/article/pii/S0950584914001232
https://www.researchgate.net/publication/264697060_Ongoing_verification_of_a_multiphysics_community_code_FLASH

Resources for Trilinos testing:
Trilinos testing policy: https://github.com/trilinos/Trilinos/wiki/Trilinos-Testing-Policy
Trilinos test harness: https://github.com/trilinos/Trilinos/wiki/Policies--%7C-Testing

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Agenda

Tutorial evaluation form: http://bit.ly/sc17-eval

Time	Topic	Speaker
8:30am-8:45am	Why effective software practices are essential for CSE projects	David E. Bernholdt, ORNL
8:45am-9:15am	Introduction to software licensing	David E. Bernholdt, ORNL
9:15am-9:45am	Better (small) scientific software teams	Michael A. Heroux, SNL
9:45am-10:00am	Improving Reproducibility Through Better Software Practices	Michael A. Heroux, SNL
10:00am-10:30am	*Break*	
10:30am-10:45am	Testing of HPC Scientific Software: Introduction	Alicia M. Klinvex, SNL
10:45am-11:15am	Verification	Anshu Dubey, ANL
11:15am-11:45am	Evaluating project testing needs	Anshu Dubey, ANL
11:45am-12:00pm	Code coverage demo and CI demo	Alicia M. Klinvex, SNL

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