Regression Testing

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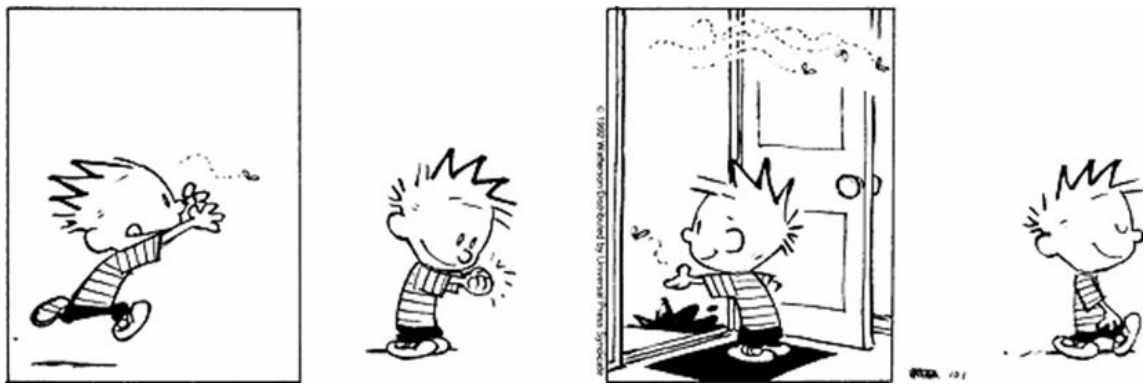
What is regression testing?

Regression testing is a type of software testing that verifies that software previously developed and tested still performs correctly even after it was **changed** or interfaced with other software.

What is regression testing?

During regression testing, new **software bugs** or **regressions** may be uncovered.

Regression:
"when you fix one bug, you introduce several newer bugs."



Why do we do it?

Systems are interconnected and the change may have had an unexpected impact on another part of the system.

When do we do it?

Whenever we make a change.

How is it implemented?

There are various approaches:

- Retest All: This method of regression testing simply re-tests the entirety of the software, using the existing tests.
- Regression Test Selection: Rather than a full re-test process, this method allows the the team to choose a representative selection of tests that will approximate a full testing of the test suite, but require far less time or cost to do so.
- Test Case Prioritization: With a set of limited test cases, it is ideal to prioritize those tests. Try to prioritize tests which could impact both current and future builds of the software.

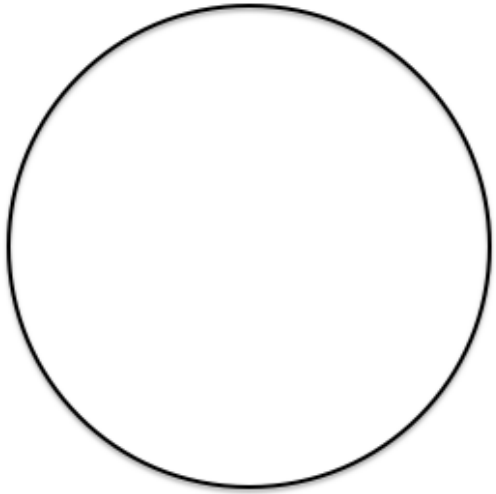
Aim for maximum code coverage

Best Practices

Best practices to follow when implementing regression testing

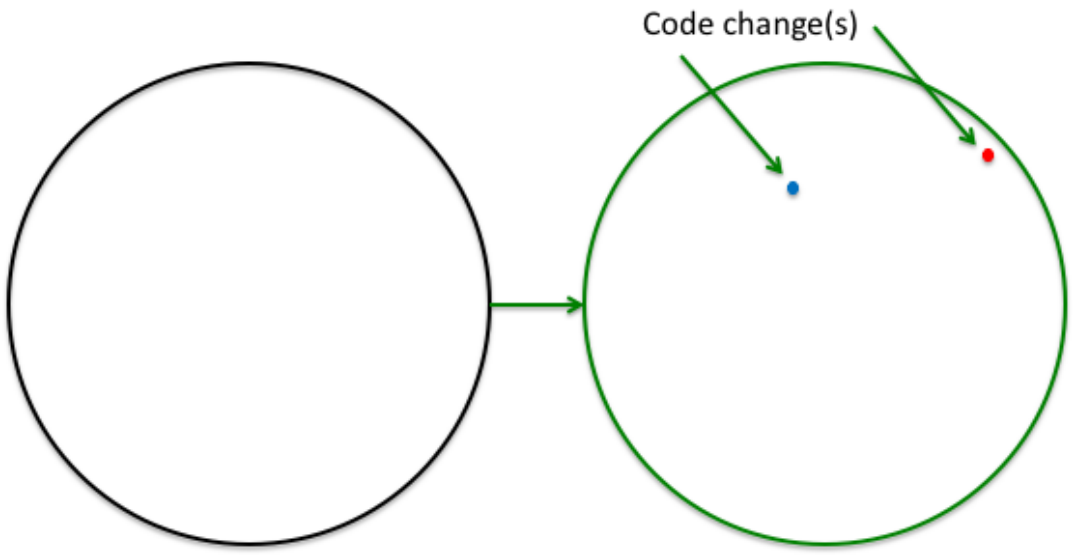
- Maintain a Schedule
- Use a Test Management Tool
- Break Down and Categorize Tests
- Perform Exploratory Testing

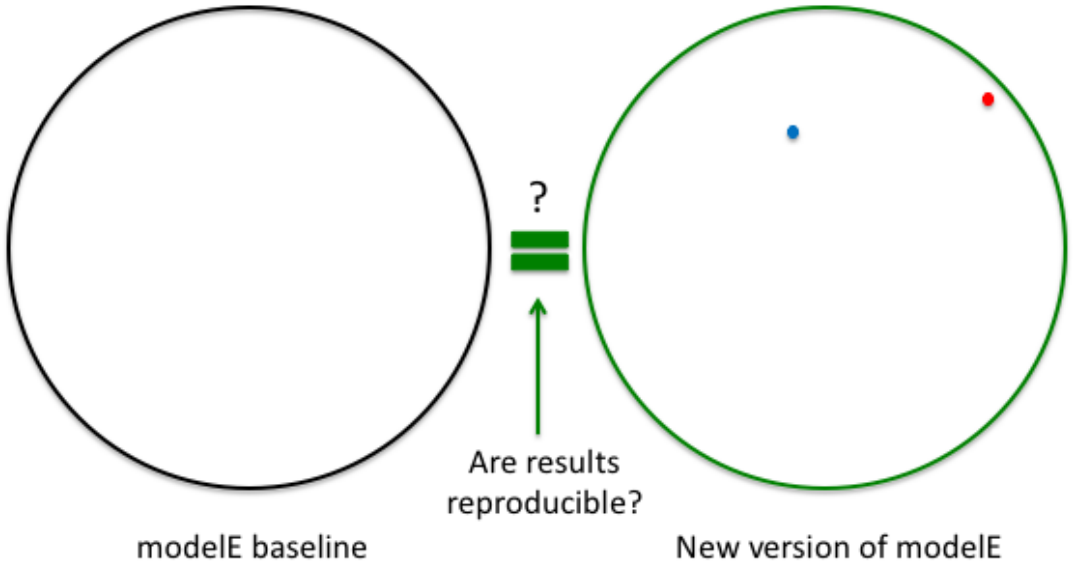
Example: GISS modelE

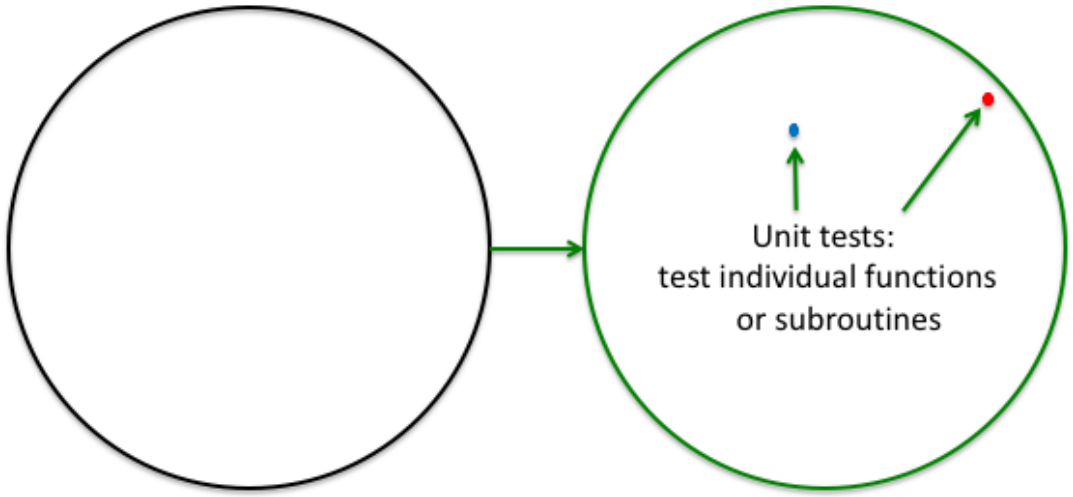


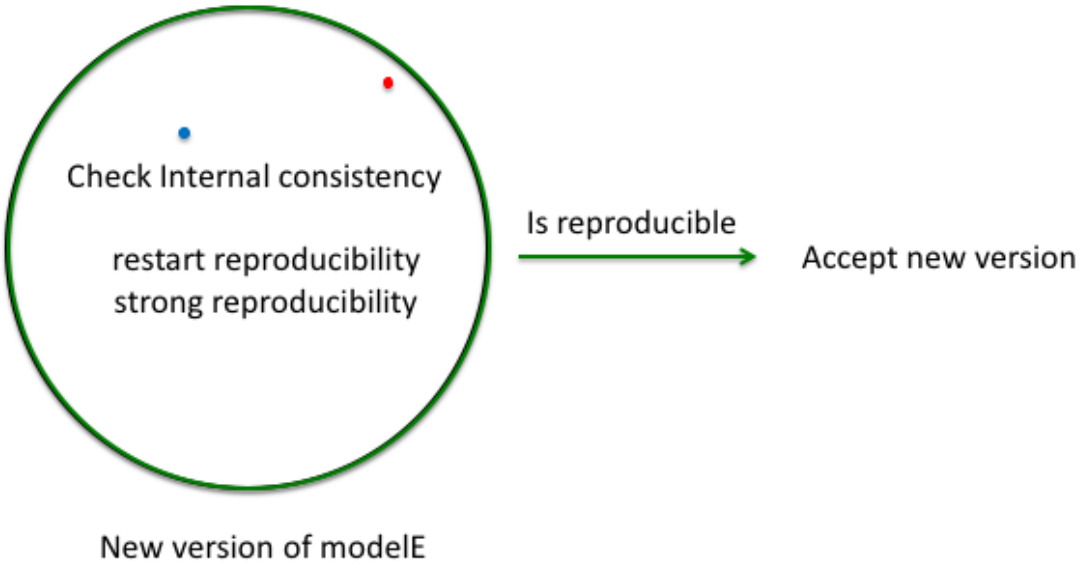
modelE baseline

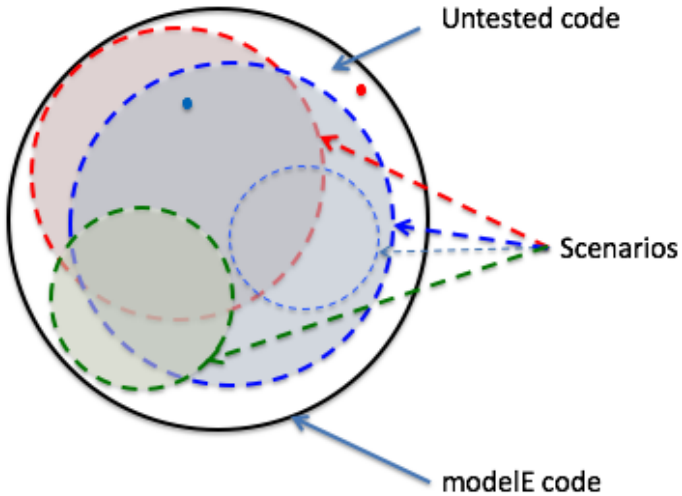
*https://www.giss.nasa.gov/tools/modelE/


Code change(s)
modelE baseline
New version of modelE


?
Are results reproducible?
modelE baseline
New version of modelE


Unit tests:
test individual functions
or subroutines
modelE baseline
New version of modelE


Check Internal consistency
restart reproducibility
strong reproducibility
Is reproducible
Accept new version
New version of modelE



- Other recommendations[1]:
  - Test with multiple compiler vendors
  - Multiple modes (serial and MPI)
  - Multiple NPEs

[1] Increases *cost*

Results

```
Regression testing of modelE E2.1_branch branch
Repository: /discover/nobackup/ccruz/devel/modelE.clones/simplex/E2.1_branch
================================================================================
Branch: E2.1_branch  --  Build type: release
================================================================================
                                                          -REPRODUCIBILITY
              RUNDECK  COMPILER    MODE    RUN    UNT    BAS    RST    NPE
================================================================================
               E1oM20  gfortran     mpi      +      -      +      +      +
               E1oM20  gfortran  serial      +      -      +      +      -
               E1oM20     intel     mpi      +      -      +      +      +
               E1oM20     intel  serial      +      -      +      +      -
            E4TcadC12  gfortran     mpi      +      -      3      6      3
            E4TcadC12  gfortran  serial      +      -      +      3      -
            E4TcadC12     intel     mpi      +      -      +      3      +
            E4TcadC12     intel  serial      +      -      +      3      -
                E6F40  gfortran     mpi      +      -      +      +      +
                E6F40  gfortran  serial      +      -      +      +      -
                E6F40     intel     mpi      +      -      +      +      +
                E6F40     intel  serial      +      -      +      +      -
      E6TlernerpsvF40  gfortran     mpi      +      -      +      3      +
      E6TlernerpsvF40  gfortran  serial      +      -      +      3      -
      E6TlernerpsvF40     intel     mpi      +      -      +      3      +
      E6TlernerpsvF40     intel  serial      +      -      +      3      -
         E6TmatrixF40  gfortran     mpi      +      -      +      1      -
         E6TmatrixF40     intel     mpi      +      -      +      1      -
            E6TomaF40  gfortran     mpi      +      -      +      4      -
            E6TomaF40     intel     mpi      +      -      +      4      -
         E6TomaF40int  gfortran     mpi      +      -      +      4      -
         E6TomaF40int     intel     mpi      +      -    455      8      -
  E6TtomasF40clim2000  gfortran     mpi      +      -      +      4      -
  E6TtomasF40clim2000     intel     mpi      +      -      +      4      -
            E6TvsdF40  gfortran     mpi      +      -      +      +      +
            E6TvsdF40  gfortran  serial      +      -      +      +      -
            E6TvsdF40     intel     mpi      +      -      +      +      -
            E6TvsdF40     intel  serial      +      -      +      +      -
           E6TwisoF40  gfortran     mpi      +      -      +      4      -
           E6TwisoF40  gfortran  serial      +      -      +      4      -
           E6TwisoF40     intel     mpi      +      -      +      4      -
           E6TwisoF40     intel  serial      +      -      +      4      -
            E_AR5_C12  gfortran     mpi      +      -      3      3      3
            E_AR5_C12  gfortran  serial      +      -      3      +      -
            E_AR5_C12     intel     mpi      +      -      +      +      -
            E_AR5_C12     intel  serial      +      -      +      +      -
                 EM20  gfortran     mpi      +      -      +      +      +
                 EM20  gfortran  serial      +      -      +      +      -
                 EM20     intel     mpi      +      -      +      +      +
                 EM20     intel  serial      +      -      +      +      -
       ENINT2.1otrac     intel     mpi      +      -      -      -      -
               LLF40  gfortran     mpi      +      -      +      +      -
               LLF40  gfortran  serial      +      -      +      +      -
               LLF40     intel     mpi      +      -      +      +      +
               LLF40     intel  serial      +      -      +      +      -
            SGP4TESTS  gfortran  serial      +      -      +     F*      -
            SGP4TESTS     intel  serial      +      -      +     F*      -
================================================================================
Time taken = 01:18:14
================================================================================
Legend:
-------
+   : success
C   : created baseline
Fb  : build failure
F1  : 1hr run-time failure
Fr  : restart run-time failure
F*  : expected failure
U   : unexpected system failure
NUM : number of reproducibility differences
-   : not available
Notes:
------
intel compiler version: 14.0.3.174
gfortran compiler version: 4.9.1
Results in: /discover/nobackup/ccruz/regTesting/modelE/E2.1_branch/results/E2.1_branch
================================================================================
Commits from last day:
d90f0bd - Gary L. Russell, 9 hours ago : Merging master with LAKES2.F90 commit.
1c51258 - Gary L. Russell, 10 hours ago : LAKES2.F90 differs from LAKES.f by the following:
```

Results

```
Regression testing of NU-WRF Charney patch 1 code base
Repository: /discover/nobackup/ccruz/devel/nu-wrf/code/nu-wrf
-------------------------------------------------------------------------------
Branch: develop  --  Build type: release
-------------------------------------------------------------------------------
         BUILD and/or RUN NAME                COMPILER         RESULT   BASELINE
-------------------------------------------------------------------------------
                  chem                      intel-sgimpt        b+        -
                  kpp                       intel-sgimpt        b+        -
                  scm                       intel-sgimpt        b+        -
                  wrf                       intel-sgimpt        b+        -
       chem_3iceg_2014rad_gocart            intel-sgimpt        r+        vF
       chem_3iceh_2014rad_gocart            intel-sgimpt        r+        vF
        chem_4ice_2014rad_gocart            intel-sgimpt        r+        vF
     chem_4ice_2014rad_merra2aero           intel-sgimpt        r+        vF
      chem_4ice_2014rad_merraero            intel-sgimpt        r+        vF
   chem_4ice_2014rad_offline_gocart         intel-sgimpt        r+        vF
            chem_casaco2                    intel-sgimpt        r+        vF
           chem_erod_dyn                    intel-sgimpt        r+        vF
         chem_erod_dynclimo                 intel-sgimpt        r+        vF
           chem_erod_mdb                    intel-sgimpt        r+        vF
         chem_gfed4_gocart                  intel-sgimpt        r+        vF
          chem_gfed_gocart                  intel-sgimpt        r+        vF
        kpp_gfed4_gocartracm                intel-sgimpt        r+        vF
        kpp_gfed_gocartracm                 intel-sgimpt        r+        vF
         wrf_3iceg_2014rad                  intel-sgimpt        r+        vF
     wrf_3iceg_2014rad_lake_shi             intel-sgimpt        r+        vF
         wrf_3iceh_2014rad                  intel-sgimpt        r+        vF
          wrf_4ice_2014rad                  intel-sgimpt        r+        vF
          wrf_4ice_2017rad                  intel-sgimpt        r+        vF
          wrf_arw_katrina                   intel-sgimpt        r+        vF
            wrf_arw_post                    intel-sgimpt        rF        -
            wrf_arw_rip                     intel-sgimpt        r+        C
           wrf_arw_simple                   intel-sgimpt        r+        vF
      wrflis_nldas2_lis_spinup              intel-sgimpt        r+        vF
     wrflis_noah33_modis_merra2             intel-sgimpt        r+        vF
  wrflis_noah36_justtsk_modis_merra2        intel-sgimpt        r+        vF
      wrflis_noah36_modis_gdas              intel-sgimpt        r+        vF
 wrflis_noah36_modis_gdas_lis_spinup        intel-sgimpt        r+        vF
     wrflis_noah36_modis_merra2             intel-sgimpt        r+        vF
wrflis_noah36_modis_merra2_lis_spinup       intel-sgimpt        r+        vF
    wrflis_noah36_modis_merraland           intel-sgimpt        r+        vF
      wrflis_noah36_umd_merra2              intel-sgimpt        r+        vF
     wrflis_noah36_usgs_merra2              intel-sgimpt        r+        vF
             wrflis_scm                     intel-sgimpt        r+        vF
-------------------------------------------------------------------------------
Time taken = 05:35:48
-------------------------------------------------------------------------------
Legend:
-------
+   : task success
F   : task failure
C   : created baseline
b   : _build_ task
r   : _run_ task
v   : _verification_ task
-   : Not available
Notes:
------
intel compiler version: 17.0.4.196
gnu compiler version: 5.2
Results in: /discover/nobackup/projects/nu-wrf/regression_testing/gitrepo/results/
-------------------------------------------------------------------------------
Commits from last day:
f7c31c9c - Carlos Cruz, 13 hours ago : Check for Python version and abort if unsupported.
3f7b3594 - Carlos Cruz, 3 days ago : Major GSDSU revision (by T. Matsui)
-------------------------------------------------------------------------------
```

The End

Questions?