

Automatically Testing the Einstein Toolkit Using Github Actions

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INTRODUCTION

The Einstein Toolkit:

- A set of tools designed to be used in research of relativistic astrophysics and gravitational physics.
- The toolkit largely consists of components of the Cactus Computational Toolkit.
- Whenever a change is made to the toolkit, the components are tested via a Jenkins server
- The toolkit contains around 270 modules and 327 tests developed by researchers around the world
- It currently has 310 registered users from various institutions around the world.

Continuous Integration

- A development practice that involves integrating code into a repository frequently, which is then built and tested to locate any bugs.
- It also allows extraction of information from test results that is useful for future reference
- GitHub Actions and Jenkins both provide continuous integration services. The Einstein Toolkit uses Jenkins currently for continuous integration

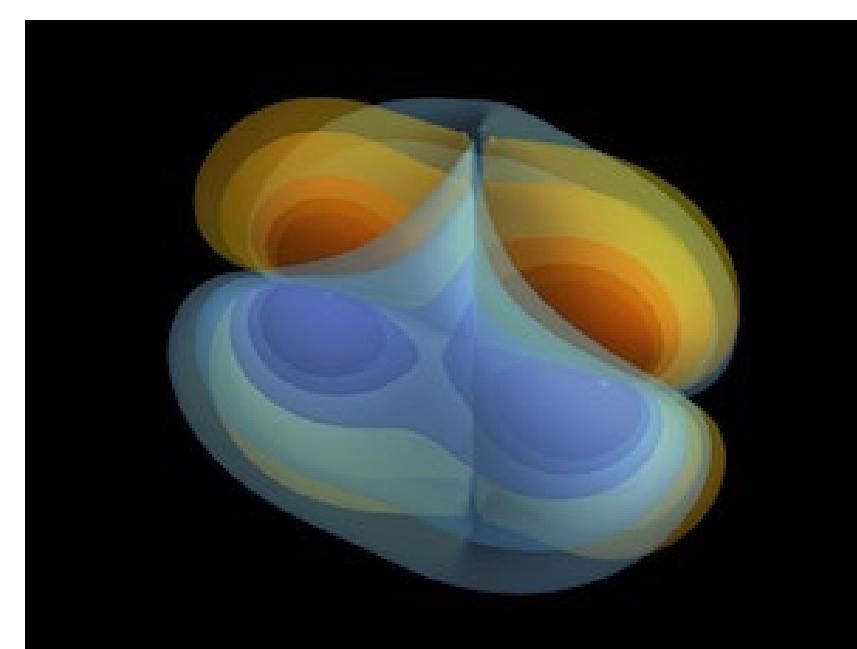


Image of Binary Black Hole Merger by Barry Wardell. Generated using the Einstein Toolkit

AIM

- Make Einstein Toolkit tests run automatically on GitHub Actions
- Display helpful data from test log files on a webpage, in order to provide more in-depth analysis than possible on the Jenkins server
- Transfer only the useful functionality from the Jenkins server to GitHub Actions
- Add interactive plots to understand parsed data
- Store information for tests to allow investigation into issues with the toolkit

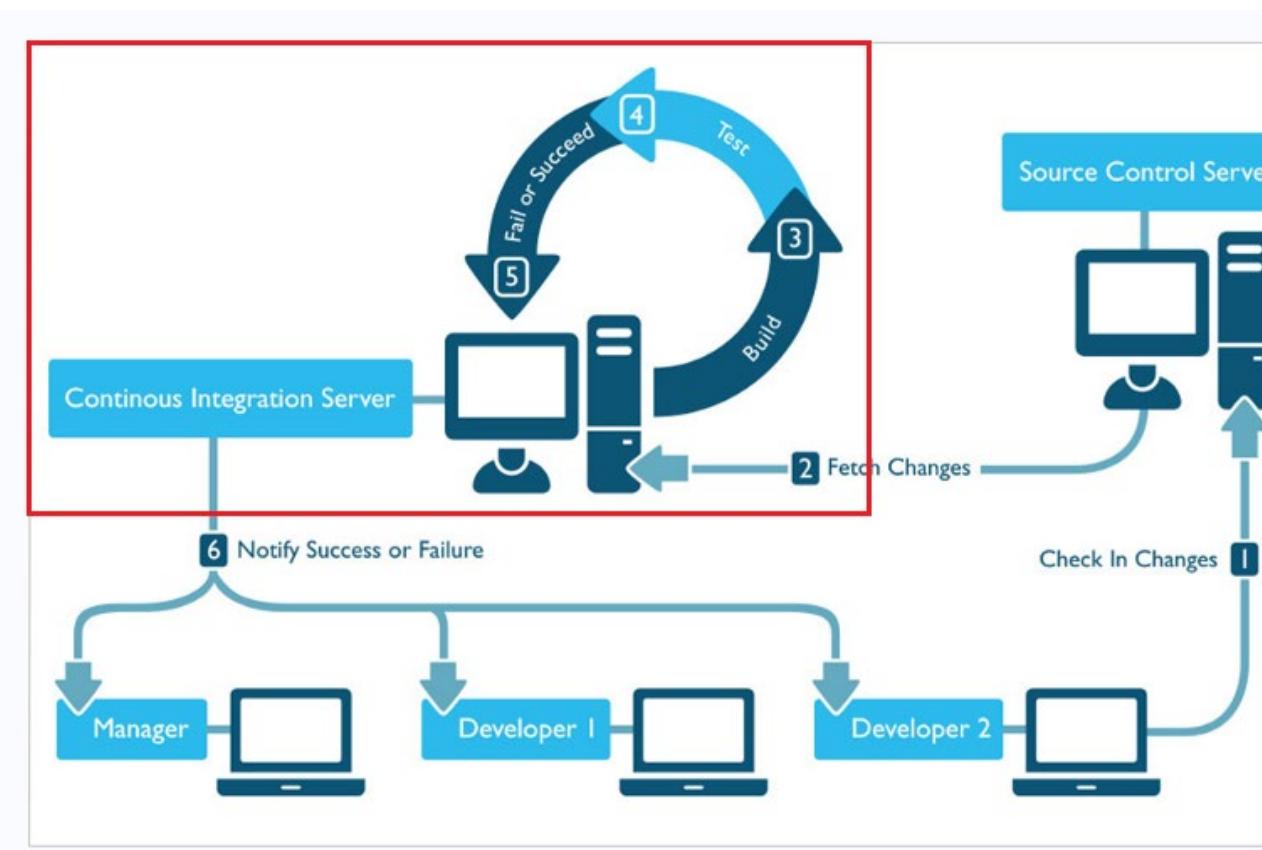


Image by Red Hat showing how a continuous integration workflow functions

METHOD

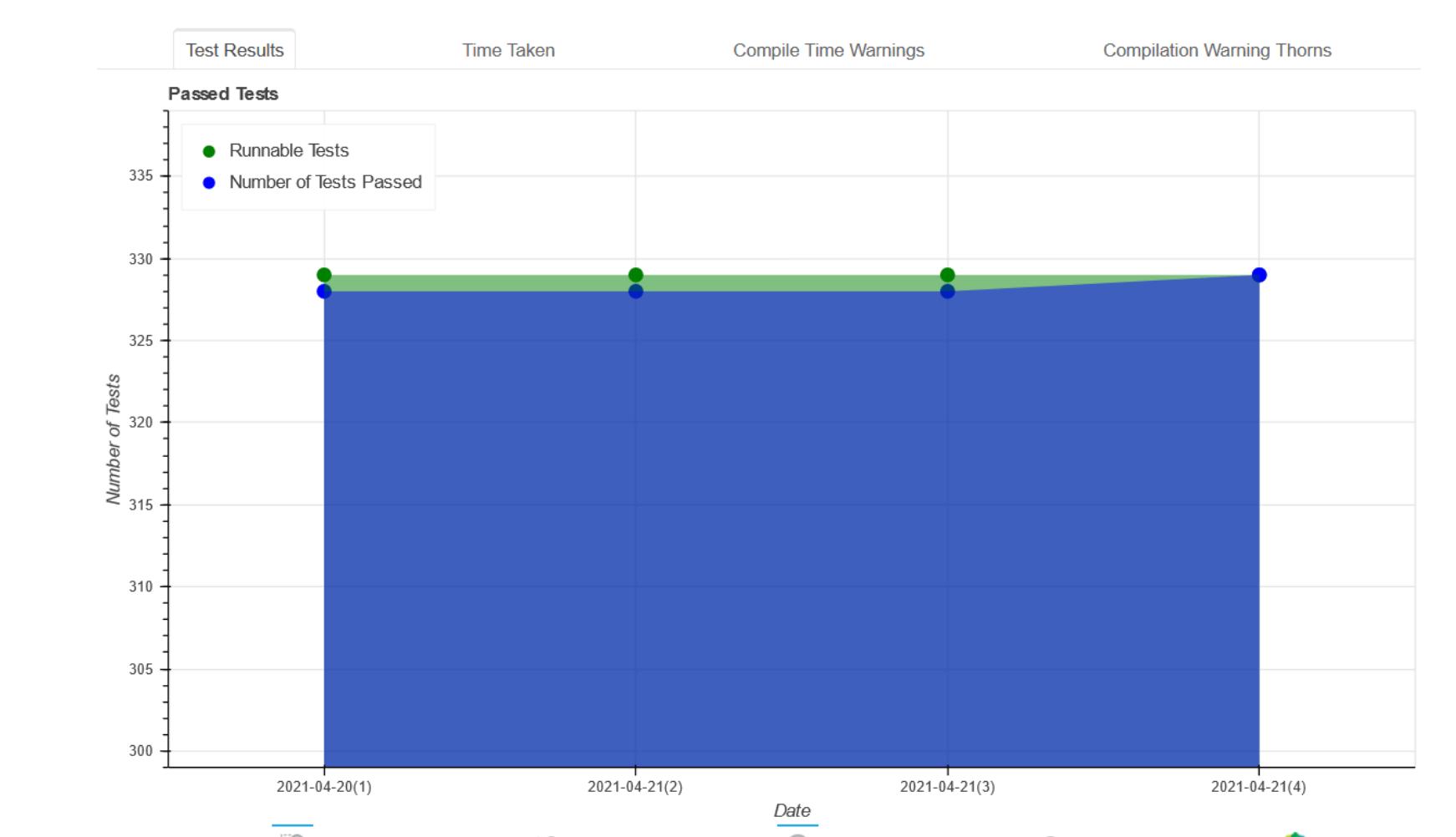
Using Python scripts, I have developed a working product that is ready for use.

The current features of my project:

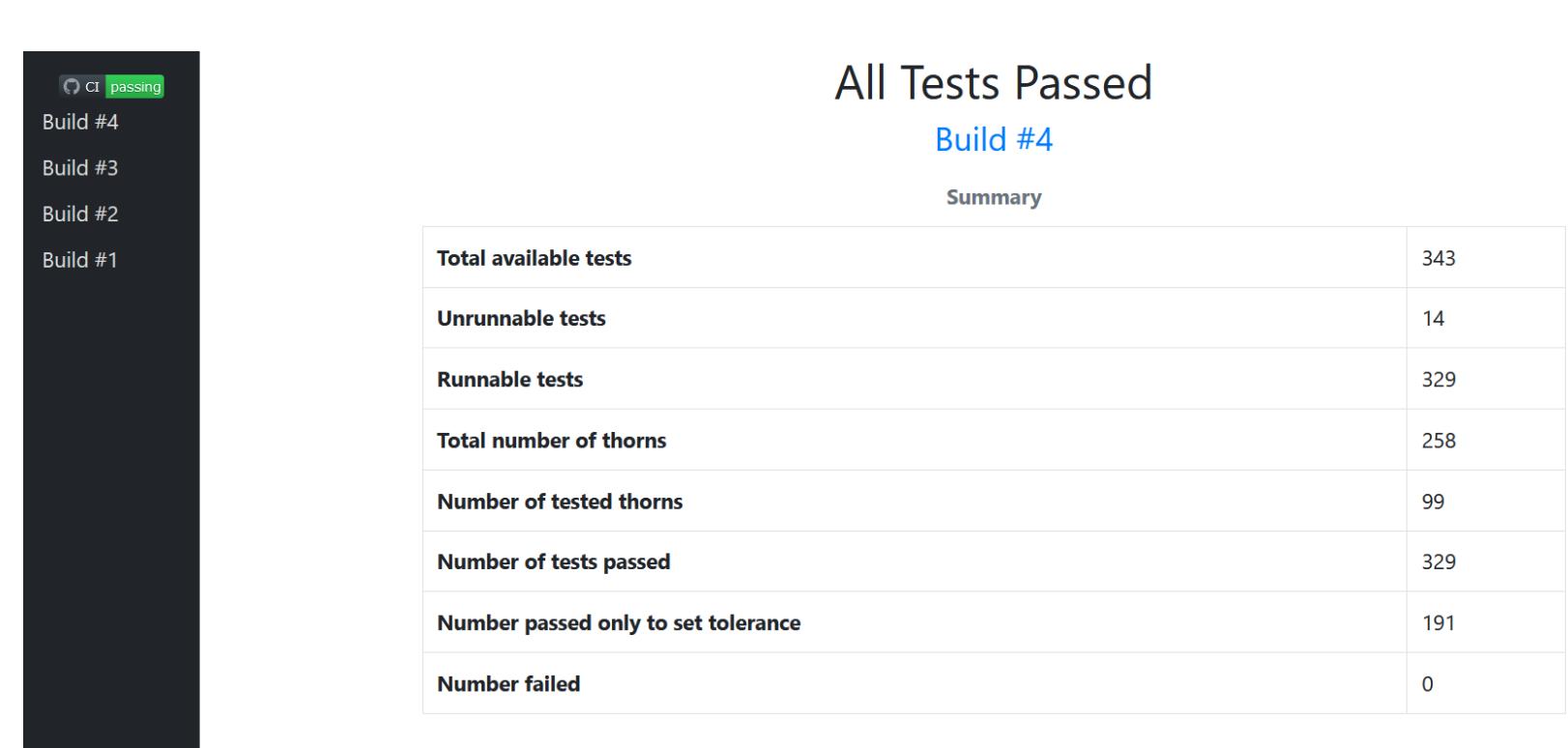
- Runs a script to build and test the toolkit, in ~1hr.
- Generates HTML report page
- Stores test summary data in csv
- Mail's maintainers with a summary of the results
- Stores compilation warnings and errors in a log file
- Stores log and diff files for each test
- Makes sure there aren't simultaneous runs of the toolkit

Data present in HTML reports include:

- Displays a summary of test results
- Links to individual test logs
- Shows test that could not be run
- Shows tests which took the longest time
- Includes interactive plot to summarize the results



Another interactive plot from the webpage

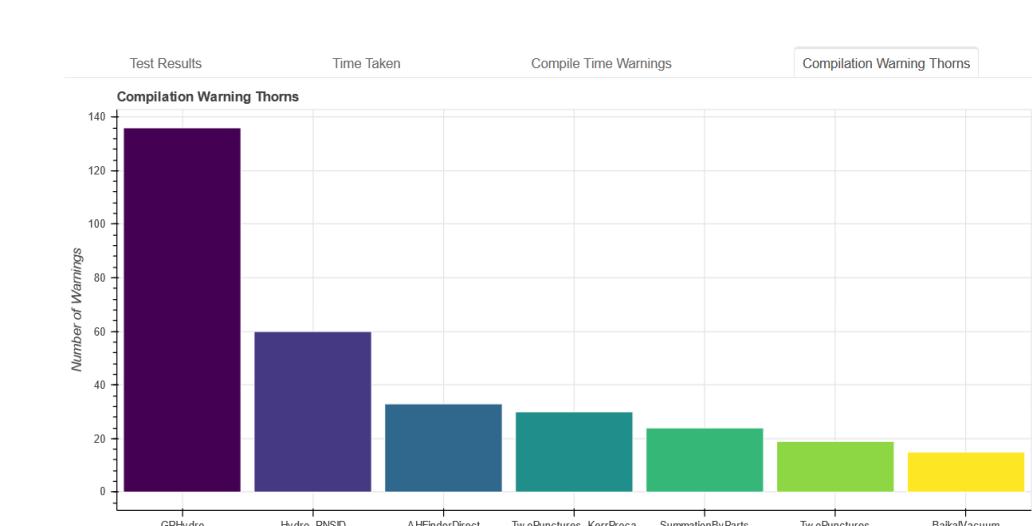


What user's see upon opening my webpage

RESULTS

The Github actions workflow is functioning well and providing information that will be useful to maintainers in the future. Some improvements from the Jenkins workflow:

- More freedom in record-keeping and thus allowing for more debugging
- Keeps track of more changes over time to trace back possible errors
- Gives more accessibility to data that was not previously readily accessible
- Adds more useful plots that summarizes data with more breadth and depth
- A more user-friendly interface to the data
- The Actions platform provides more options due to open-source nature. As a result, more significant improvements can be made.



A plot that details which modules in the Einstein Toolkit produce the most warnings

Failed Tests	log(1 process)	log(2 processes)	diffs(1 process)	diffs(2 processes)
Newly Passing Tests	balaara1_1d (from GRHydro)	Not Available	log	Not Available
Newly Failing Tests				diff
Newly Added Tests				
Removed Tests				

A table showing the changes over time of tests that fail and tests that were previously failing and are now passing and vice versa.

Test Name	Running Time
mempred	32.3s
LeeBSSN_BY_spin	48.6s
magnetized_expllosionTOV	38.8s
LeeBSSN_BY	37.4s
test_patch	30.5s
twopunctures_kerrproca_c11	30.5s
waveinterv_2p	30.4s
waveinterv_1p	29.8s
GrafFIE_tests_AlignedRotator	16.2s
magnetizedTOV_Bakal	15.1s

A table showing which tests took the most time to run.

CONCLUSIONS

The Github Actions automated system could add a lot to the improvement of the Einstein Toolkit. There are many improvements that could be made to this project. There could be additional plots, faster tests and more summarized data.

ACKNOWLEDGEMENTS

I would like to acknowledge my mentor Roland Haas, the Einstein Toolkit contributors, NCSA Gravity Group.

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Commonly used logos

