

# Better Testing Through Statistics

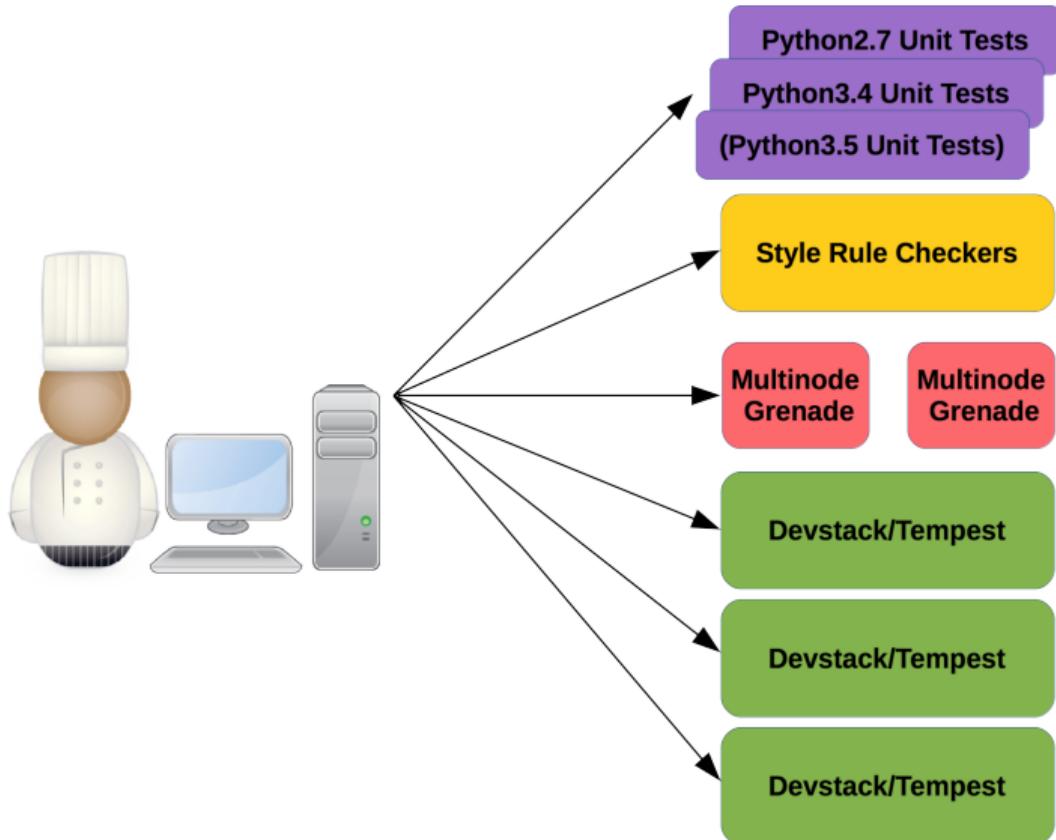
Matthew Treinish  
Open Source Developer Advocate -  
IBM mtreinish@kortar.org  
mtreinish on Freenode

Masayuki Igawa  
masayuki.igawa@gmail.com  
masayukig on Freenode

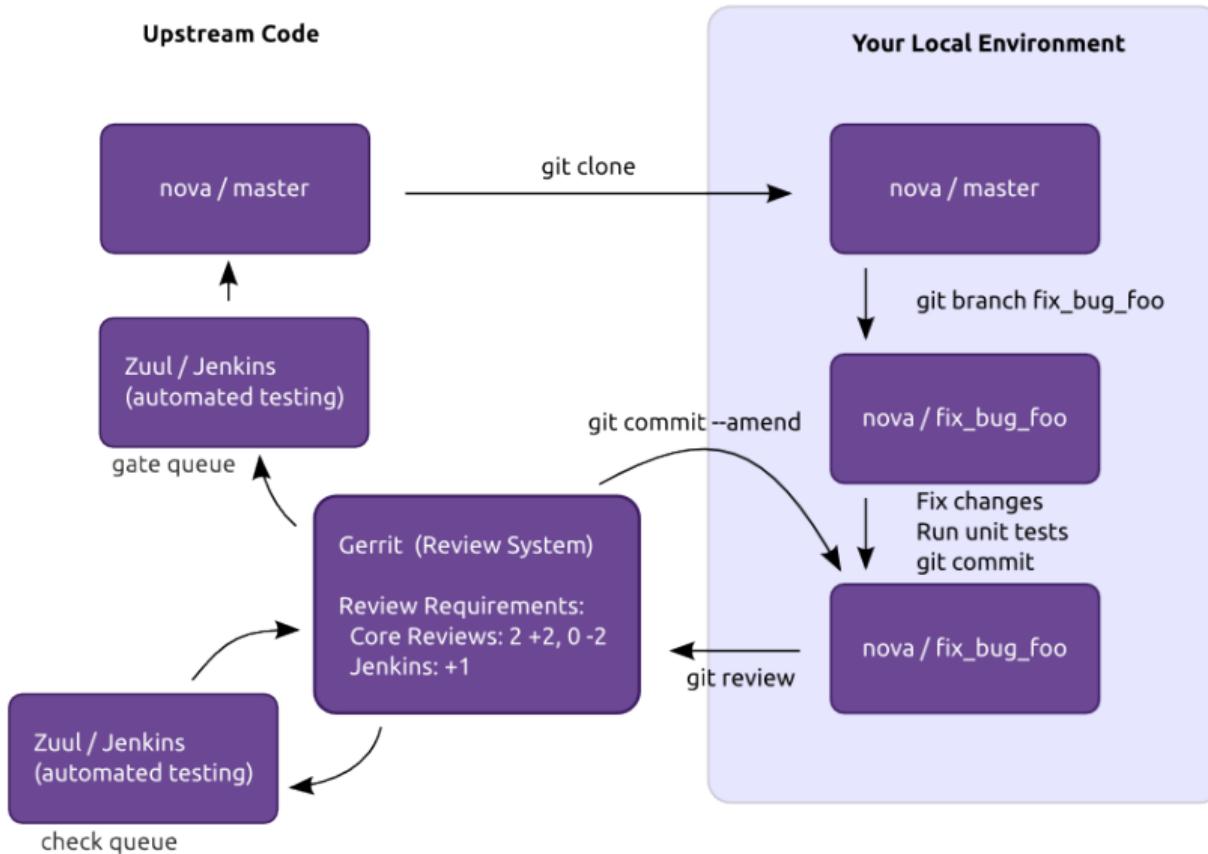
July 12, 2017

<https://github.com/masayukig/better-testing-through-statistics/tree/openwest2017>

# What Happens when you push a change?



# What is “the OpenStack Gate”?



**check**

(268)

**gate**

(26)

**post**

(79)

Newly uploaded patchsets enter this pipeline to receive an initial +1-1 Verified vote from Jenkins.

Changes that have been approved by core developers are enqueued in order in this pipeline, and if they pass tests in Jenkins, will be merged.

This pipeline runs jobs that operate after each change is merged.

Change queue: [openstack/neutron](#)

|  |           |         |             |
|--|-----------|---------|-------------|
| <a href="#">openstack/neutron</a>                                | 181574,23 | unknown | 3 hr 57 min |
| gate-neutron-docs:   | SUCCESS   |         |             |
| gate-neutron-pep8:   | SUCCESS   |         |             |
| gate-neutron-python27:   | FAILURE   |         |             |
| gate-neutron-python34:   | FAILURE   |         |             |
| gate-tempест-dsvm-neutron-full:                                  | queued    |         |             |
| gate-grenade-dsvm-neutron:                                       | SUCCESS   |         |             |
| gate-neutron-dsvm-api:   | SUCCESS   |         |             |
| gate-neutron-dsvm-functional:                                    | SUCCESS   |         |             |
| gate-neutron-dsvm-fullstack: (non-voting)                        | SUCCESS   |         |             |
| gate-rally-dsvm-neutron-neutron: (non-voting)                    | SUCCESS   |         |             |
| gate-tempест-dsvm-neutron-dvr:                                   | SUCCESS   |         |             |
| gate-tempест-dsvm-neutron-identity-v3-only-full-rv: (non-voting) | SUCCESS   |         |             |
| gate-tempест-dsvm-neutron-linuxbridge:                           | SUCCESS   |         |             |
| gate-tempест-dsvm-neutron-pg-full: (non-voting)                  | SUCCESS   |         |             |
| gate-neutron-lbaasv2-dsvm-minimal:                               | SUCCESS   |         |             |
| gate-grenade-dsvm-neutron-multinode: (non-voting)                | SUCCESS   |         |             |
| gate-grenade-dsvm-neutron-dvr-multinode: (non-voting)            | SUCCESS   |         |             |
| gate-tempест-dsvm-neutron-multinode-full: (non-voting)           | SUCCESS   |         |             |
| gate-tempест-dsvm-neutron-dvr-multinode-full: (non-voting)       | SUCCESS   |         |             |
| gate-tempест-dsvm-ironic-pxe_ipa-rv: (non-voting)                | SUCCESS   |         |             |

Change queue: [openstack/networking-generic-swift](#)

|   |          |         |             |
|---|----------|---------|-------------|
| <a href="#">openstack/networking-generic-switch</a> | 308884,3 | unknown | 3 hr 52 min |
| gate-networking-generic-switch-docs:                | queued   |         |             |
| gate-networking-generic-switch-pep8:                | SUCCESS  |         |             |
| gate-networking-generic-switch-python27:            | SUCCESS  |         |             |
| gate-networking-generic-switch-python34:            | SUCCESS  |         |             |
| gate-networking-generic-switch-dsvm:                | SUCCESS  |         |             |

Change queue: [openstack/neutron](#)

|  |           |         |             |
|--|-----------|---------|-------------|
| <a href="#">openstack/neutron</a>                                | 280595,12 | unknown | 3 hr 38 min |
| gate-neutron-docs:   | SUCCESS   |         |             |
| gate-neutron-pep8:   | SUCCESS   |         |             |
| gate-neutron-python27:   | SUCCESS   |         |             |
| gate-neutron-python34:   | SUCCESS   |         |             |
| gate-tempест-dsvm-neutron-full:                                  | SUCCESS   |         |             |
| gate-grenade-dsvm-neutron:                                       | SUCCESS   |         |             |
| gate-neutron-dsvm-api:   | SUCCESS   |         |             |
| gate-neutron-dsvm-functional:                                    | SUCCESS   |         |             |
| gate-neutron-dsvm-fullstack: (non-voting)                        | FAILURE   |         |             |
| gate-rally-dsvm-neutron-neutron: (non-voting)                    | queued    |         |             |
| gate-tempест-dsvm-neutron-dvr:                                   | SUCCESS   |         |             |
| gate-tempест-dsvm-neutron-identity-v3-only-full-rv: (non-voting) | SUCCESS   |         |             |
| gate-tempест-dsvm-neutron-linuxbridge:                           | SUCCESS   |         |             |
| gate-tempест-dsvm-neutron-pg-full (non-voting)                   | SUCCESS   |         |             |

Change queue: [integrated](#)

|  |          |       |             |
|--|----------|-------|-------------|
| <a href="#">openstack/khovva</a>             | 307269,1 | 0 min | 1 hr 10 min |
| gate-nova-docs:                              | SUCCESS  |       |             |
| gate-nova-pep8:                              | SUCCESS  |       |             |
| gate-nova-python27-db:                       | FAILURE  |       |             |
| gate-nova-python34-db:                       | FAILURE  |       |             |
| gate-nova-requirements:                      | SUCCESS  |       |             |
| gate-tempест-dsvm-full:                      | SUCCESS  |       |             |
| gate-tempест-dsvm-postgres-full:             | SUCCESS  |       |             |
| gate-tempест-dsvm-neutron-full:              | SUCCESS  |       |             |
| gate-grenade-dsvm:                           | SUCCESS  |       |             |
| gate-nova-releasenotes:                      | SUCCESS  |       |             |
| gate-nova-tox-db-functional:                 | SUCCESS  |       |             |
| gate-grenade-dsvm-multinode:                 | SUCCESS  |       |             |
| gate-tempест-dsvm-cells:                     | SUCCESS  |       |             |
| gate-tempест-dsvm-full-devstack-plugin-ceph: | SUCCESS  |       |             |

Change queue: [openstack/khovva](#)

|  |          |       |             |
|--|----------|-------|-------------|
| <a href="#">openstack/khovva</a>             | 304730,1 | 0 min | 1 hr 10 min |
| gate-nova-docs:                              | SUCCESS  |       |             |
| gate-nova-pep8:                              | SUCCESS  |       |             |
| gate-nova-python27-db:                       | SUCCESS  |       |             |
| gate-nova-python34-db:                       | SUCCESS  |       |             |
| gate-tempест-dsvm-full:                      | SUCCESS  |       |             |
| gate-tempест-dsvm-postgres-full:             | SUCCESS  |       |             |
| gate-tempест-dsvm-neutron-full:              | SUCCESS  |       |             |
| gate-grenade-dsvm:                           | SUCCESS  |       |             |
| gate-nova-releasenotes:                      | SUCCESS  |       |             |
| gate-nova-tox-db-functional:                 | SUCCESS  |       |             |
| gate-grenade-dsvm-multinode:                 | SUCCESS  |       |             |
| gate-tempест-dsvm-cells:                     | SUCCESS  |       |             |
| gate-tempест-dsvm-full-devstack-plugin-ceph: | SUCCESS  |       |             |

Change queue: [openstack/neutron](#)

|  |          |       |            |
|--|----------|-------|------------|
| <a href="#">openstack/neutron</a>            | 303995,1 | 0 min | 1 hr 5 min |
| gate-nova-docs:                              | SUCCESS  |       |            |
| gate-nova-pep8:                              | SUCCESS  |       |            |
| gate-nova-python27-db:                       | SUCCESS  |       |            |
| gate-nova-python34-db:                       | SUCCESS  |       |            |
| gate-tempест-dsvm-full:                      | SUCCESS  |       |            |
| gate-tempест-dsvm-postgres-full:             | SUCCESS  |       |            |
| gate-tempест-dsvm-neutron-full:              | SUCCESS  |       |            |
| gate-grenade-dsvm:                           | SUCCESS  |       |            |
| gate-nova-releasenotes:                      | SUCCESS  |       |            |
| gate-nova-tox-db-functional:                 | SUCCESS  |       |            |
| gate-grenade-dsvm-multinode:                 | SUCCESS  |       |            |
| gate-tempест-dsvm-cells:                     | SUCCESS  |       |            |
| gate-tempест-dsvm-full-devstack-plugin-ceph: | SUCCESS  |       |            |

Change queue: [openstack-dev/devstack](#)

|  |          |       |            |
|--|----------|-------|------------|
| <a href="#">openstack-dev/devstack</a> | 308791,1 | 0 min | 1 hr 5 min |
| gate-devstack-docs:                    | SUCCESS  |       |            |

Change queue: [openstack/osl.concurrency](#)

|  |         |         |            |
|--|---------|---------|------------|
| <a href="#">openstack/osl.concurrency</a>    | 342ef3d | unknown | 5 hr 2 min |
| osl/concurrency-branch-tarball:              | SUCCESS |         |            |
| osl/concurrency-docs:                        | queued  |         |            |
| osl/concurrency-upstream-translation-update: | SUCCESS |         |            |
| osl/concurrency-coverage:                    | queued  |         |            |

Change queue: [openstack-infra/project-config](#)

|  |         |         |            |
|--|---------|---------|------------|
| <a href="#">openstack-infra/project-config</a> | 08001cc | unknown | 5 hr 0 min |
| publish-infra-docs-index:                      | queued  |         |            |
| publish-specs-site:                            | queued  |         |            |

Change queue: [openstack/networking-vsphere](#)

|  |          |         |             |
|--|----------|---------|-------------|
| <a href="#">openstack/networking-vsphere</a> | 1931febe | unknown | 4 hr 55 min |
| networking-vsphere-branch-tarball:           | queued   |         |             |
| networking-vsphere-docs:                     | queued   |         |             |

Change queue: [openstack-infra/project-config](#)

|  |         |         |             |
|--|---------|---------|-------------|
| <a href="#">openstack-infra/project-config</a> | d7f08ff | unknown | 4 hr 54 min |
| publish-infra-docs-index:                      | queued  |         |             |
| publish-specs-site:                            | queued  |         |             |

Change queue: [openstack-infra/project-config](#)

|  |         |         |             |
|--|---------|---------|-------------|
| <a href="#">openstack-infra/project-config</a> | 8cb6337 | unknown | 4 hr 52 min |
| publish-infra-docs-index:                      | queued  |         |             |
| publish-specs-site:                            | queued  |         |             |

Change queue: [openstack/stackalytics](#)

|  |         |         |            |
|--|---------|---------|------------|
| <a href="#">openstack/stackalytics</a> | 40f07b8 | unknown | 4 hr 7 min |
| hook-stackalyticcs-rtfd:               | SUCCESS |         |            |
| stackalytics-branch-tarball:           | queued  |         |            |

Change queue: [openstack/stackalytics](#)

|  |         |         |            |
|--|---------|---------|------------|
| <a href="#">openstack/stackalytics</a> | a5e5a37 | unknown | 4 hr 7 min |
| hook-stackalyticcs-rtfd:               | SUCCESS |         |            |
| stackalytics-branch-tarball:           | queued  |         |            |

Change queue: [openstack/governance](#)

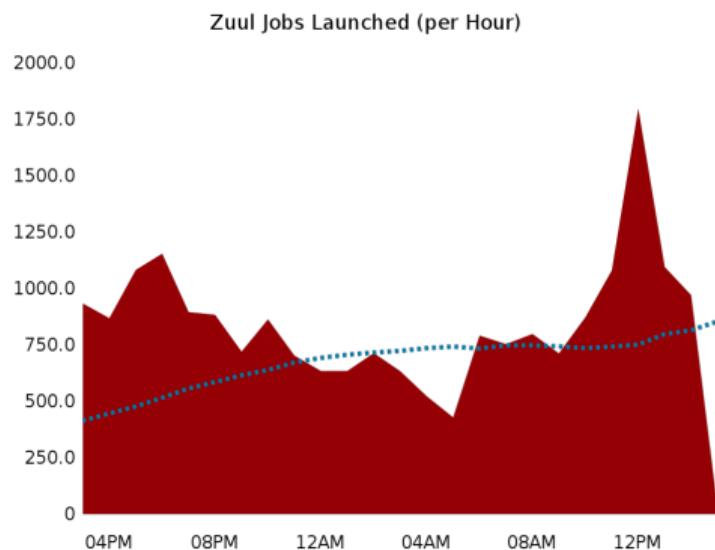
# The Size of the Gate

## One Proposed Change Generates:

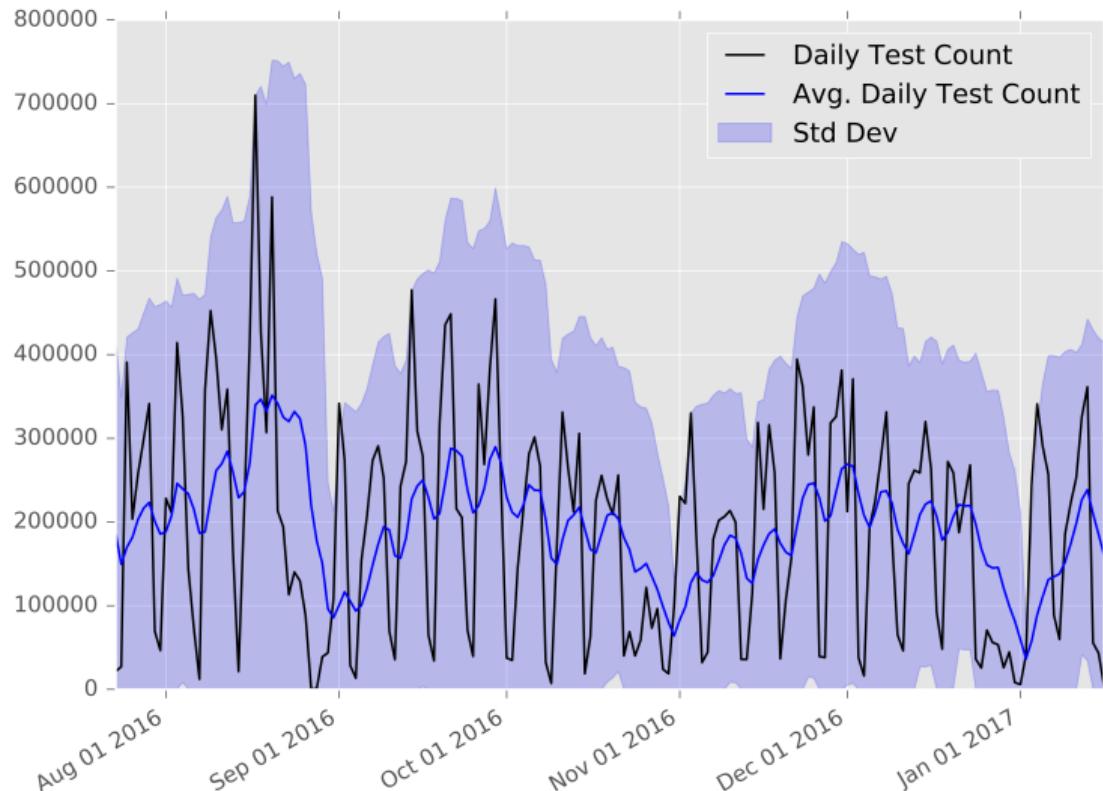
- ▶ 5–25 Devstacks
- ▶ ~10,000 integration tests (roughly 1.5k per devstack)
- ▶ ~151 2nd level guests created in each devstack cloud
- ▶ ~1 GB of logs uncompressed for each run

## In aggregate:

- ▶ ~12,500 jobs run in check and gate daily
- ▶ ~0.01% individual tempest test failure rate
- ▶ ~.77% tempest run failure rate

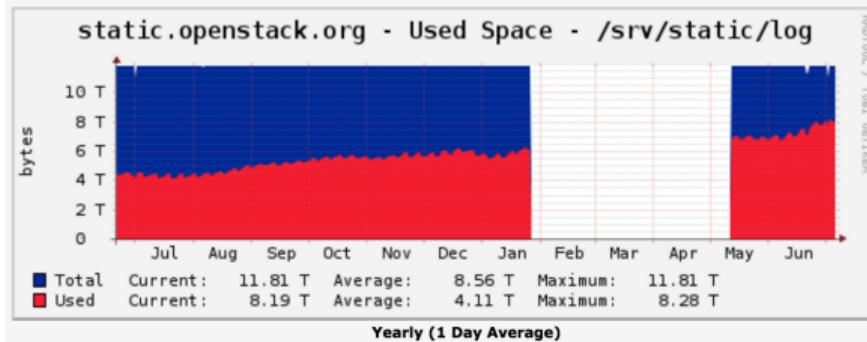
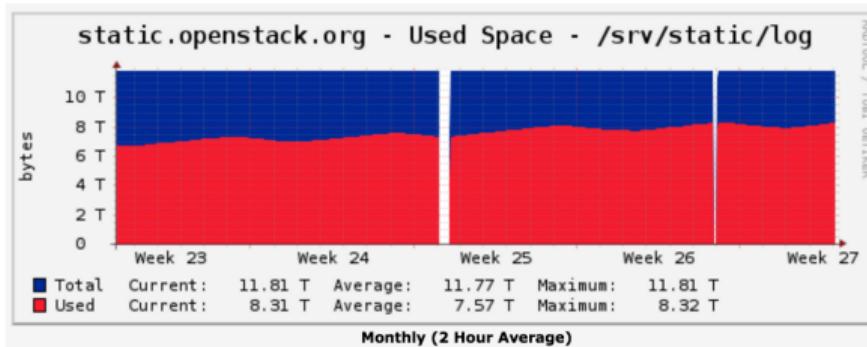


## Number of Tempest Tests per Day in the Gate Queue:



# Log Server

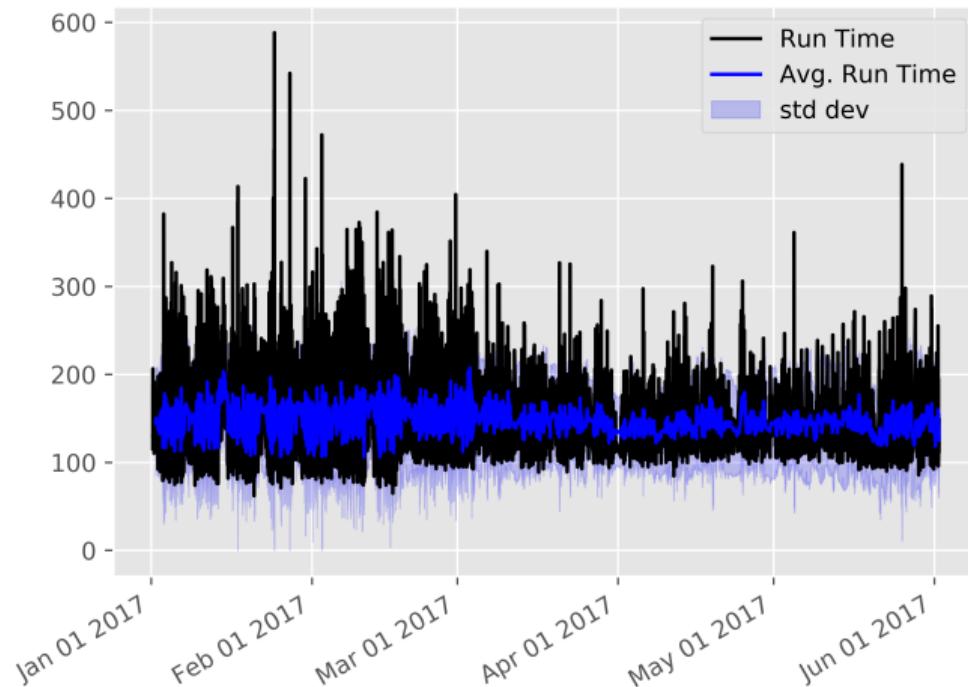
- ▶ Log Server: <http://logs.openstack.org/>
- ▶ Archive of all artifacts from all jobs for ~4 months
- ▶ ~8 TB of data compressed



## Problems/Issues when Running in the Gate

- ▶ Works fine for looking at results 1 at a time
- ▶ Difficult to find non-deterministic failures
- ▶ Difficult to find performance regressions
- ▶ Finding out how often something passes or fails is next to impossible

## Runtime variance



## General Approach

- ▶ Look at things on the larger scale
- ▶ Use statistics and data mining to find previously unknown trends in OpenStack
- ▶ Make the data from test runs open and accessible to everyone
- ▶ Ensure there are APIs available for accessing everything

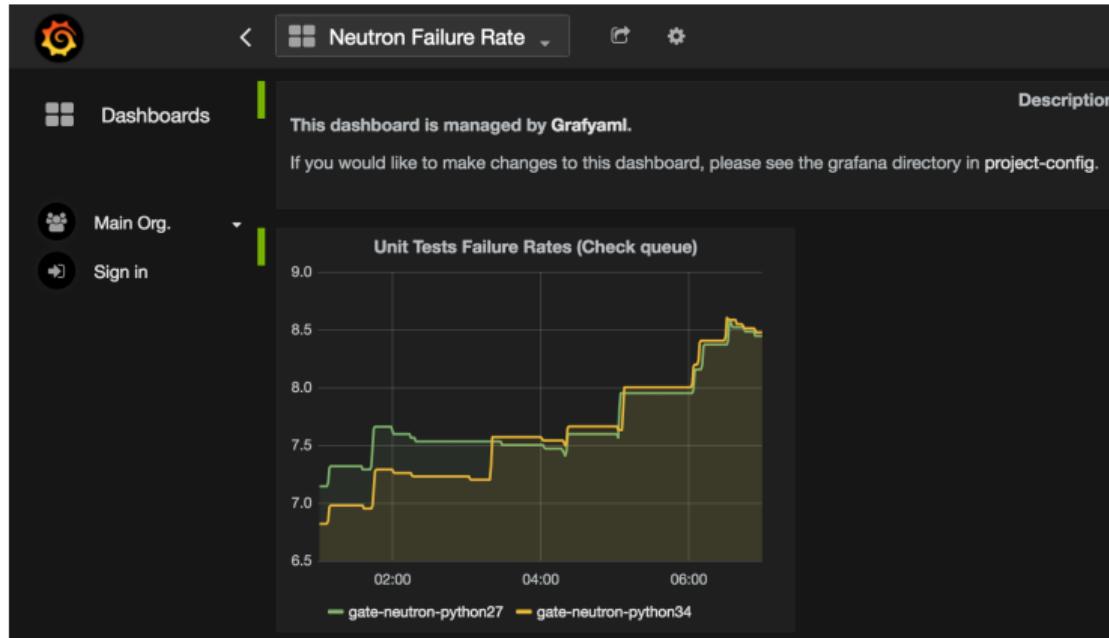
# Graphite

- ▶ <http://graphite.openstack.org/>
- ▶ Infra services report to graphite
- ▶ Include job results
- ▶ Limited to job level data
- ▶ Time based, can't be linked to an individual job



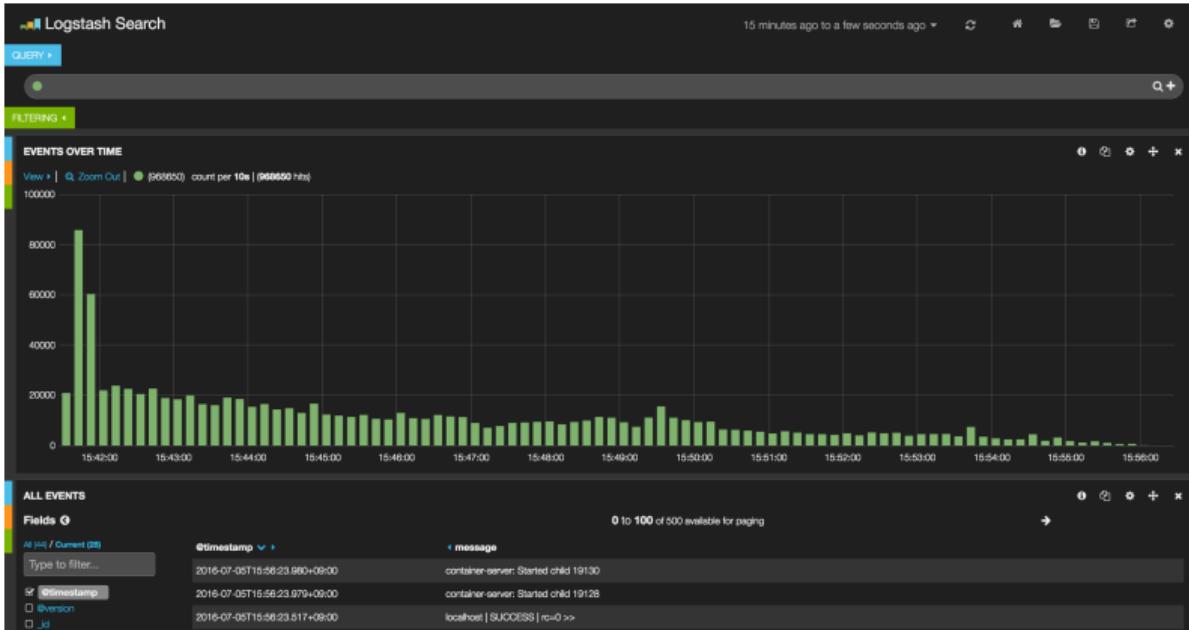
# Grafana

- ▶ <http://grafana.openstack.org/>
- ▶ Provides a layer on top of graphite to easily make useful visualizations
- ▶ Adds a number of dashboards
- ▶ Some projects using this to track job failure rates



# ELK

- ▶ Elasticsearch, Logstash, Kibana
- ▶ <http://logstash.openstack.org>
- ▶ Provides a search engine on top of are job artifacts
- ▶ Limited to 10 days of results

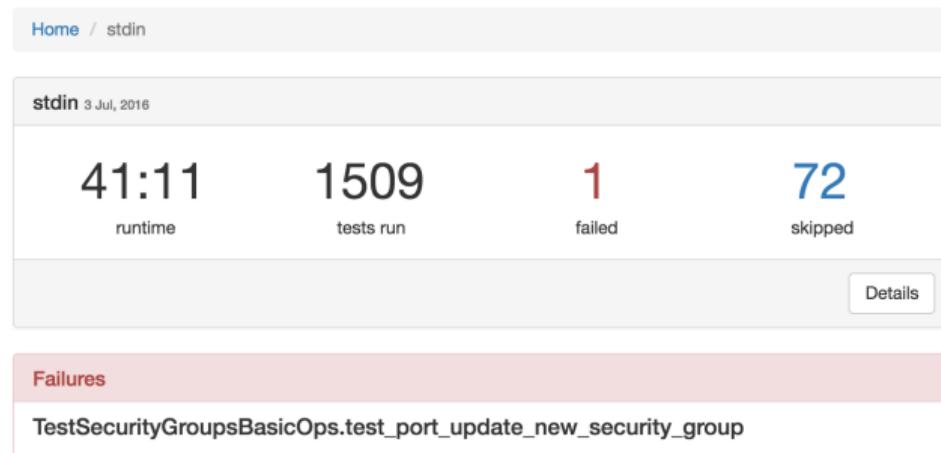


# StackViz

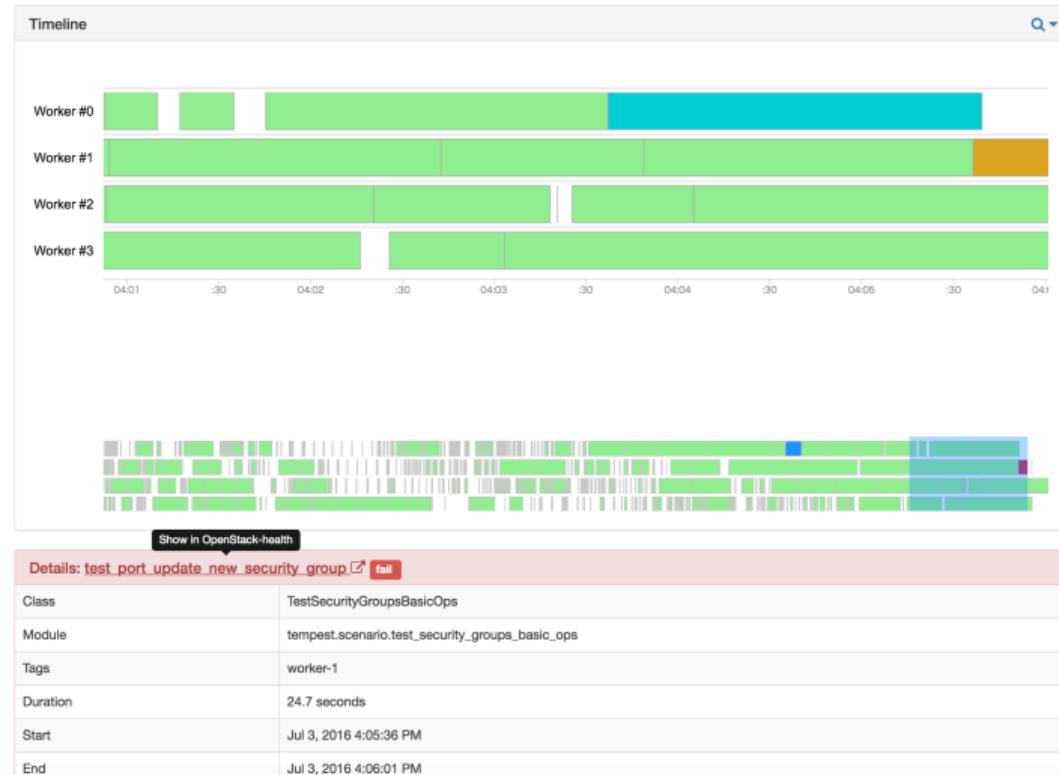
Visualization tool of individual CI build results

► [git.openstack.org/cgit/openstack/stackviz](https://git.openstack.org/cgit/openstack/stackviz)

## Datasets

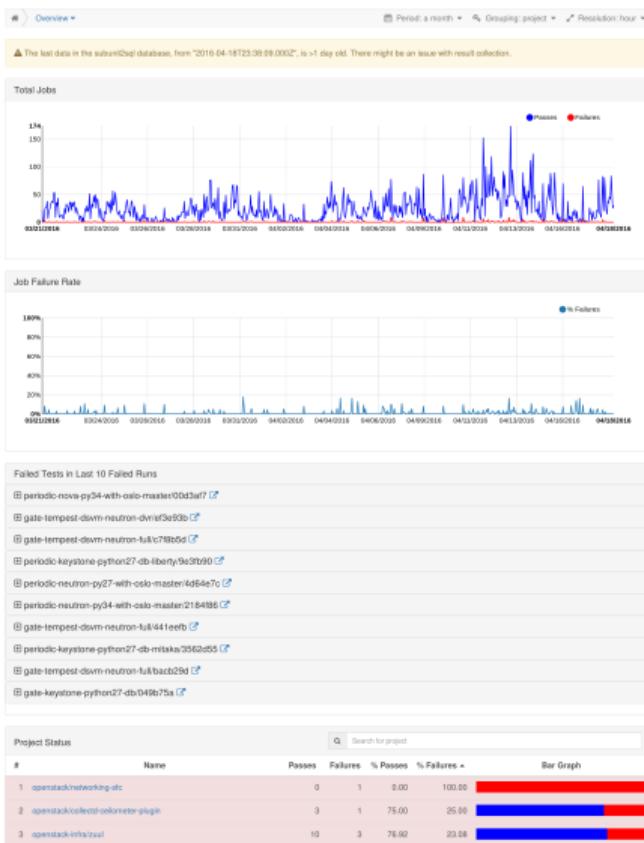


# StackViz: Timeline



# Using OpenStack Health

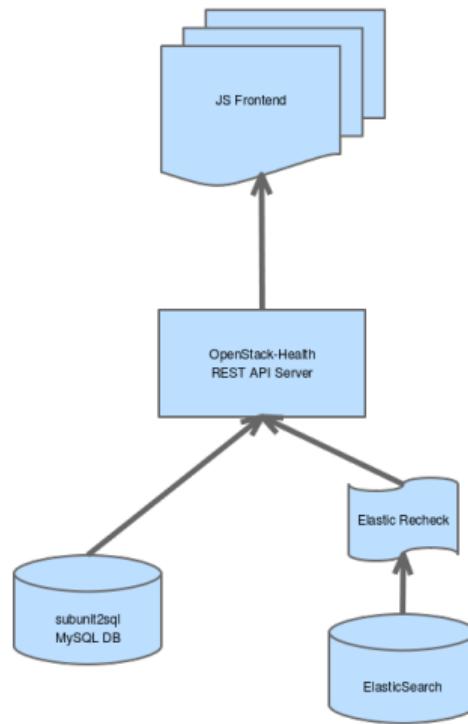
OpenStack Health is a dashboard for visualizing test results of OpenStack CI jobs.



## openstack-health

- ▶ <http://status.openstack.org/openstack-health/#/>
- ▶ Designed to be a single point of access for all the data about the gate
- ▶ Currently can leverage subunit2sql and elastic-recheck

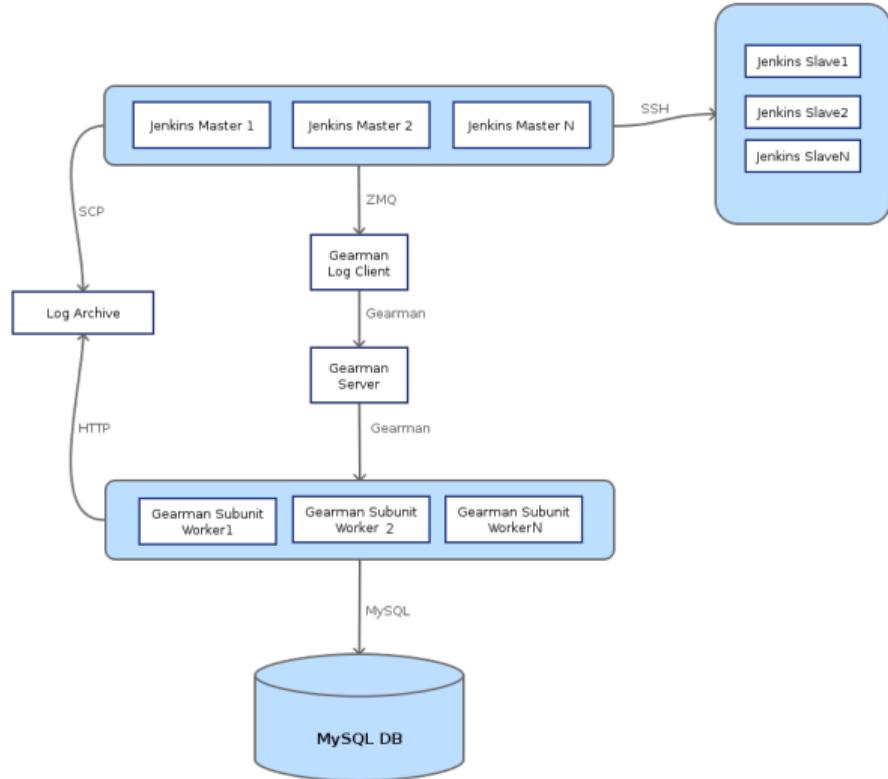
# OpenStack-Health Architecture



## subunit2sql

- ▶ Designed to store test results data in a sql database
- ▶ Provides a DB schema and a python API for interacting with the database
- ▶ CLI utilities for storing and retrieving results in the DB as subunit v2
- ▶ A public database of everything with subunit output run in OpenStack-Infra
- ▶ Used to store the results from test runs for 6 months

# subunit2sql in OpenStack Infrastructure



## Elastic Recheck

- ▶ Designed to answer the question “Have you seen this recently?”
- ▶ Leverages elastic search to identify failures with known fingerprints
- ▶ Contains a repository of elastic-search queries with known failures
- ▶ Has 2 parts:
  - ▶ A bot which watches changes and reports identified failures to gerrit and IRC
  - ▶ A dashboard which shows failure categorization

# Elastic Recheck

<http://status.openstack.org/elastic-recheck/>

All Pipelines Gate Pipeline Uncategorized

The elastic-recheck project uses Elasticsearch to classify and track OpenStack gate failures. Documentation can be found [here](#). You can also learn more by reading this post on the Elasticsearch blog: [OpenStack elastic-recheck: powered by the elk stack](#)

Data Last Updated: Tue Jul 12 2016 13:00:01 GMT+0900 (JST)

Last Elastic Search Index Update: Tue Jul 12 2016 12:59:20 GMT+0900 (JST)

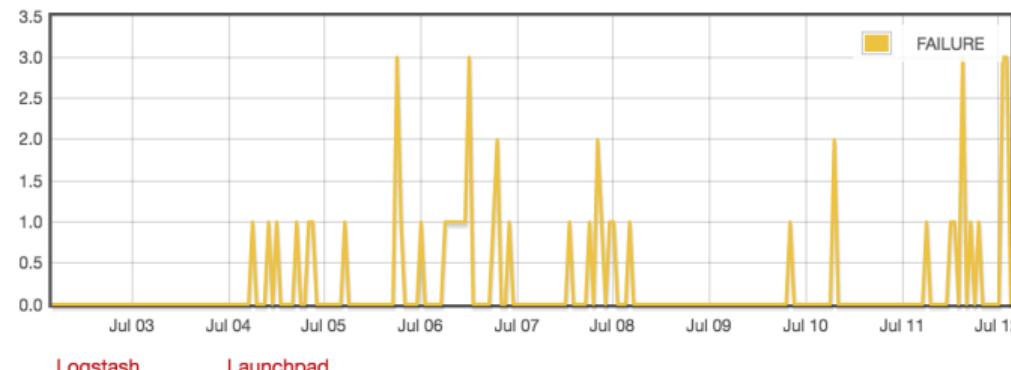
Delay in Elastic Search: Up to date

Cluster Health: green

## Bug 1539271 - Libvirt live block migration migration stalls

14 fails in 24 hrs / 50 fails in 10 days

Projects: (nova - Confirmed)



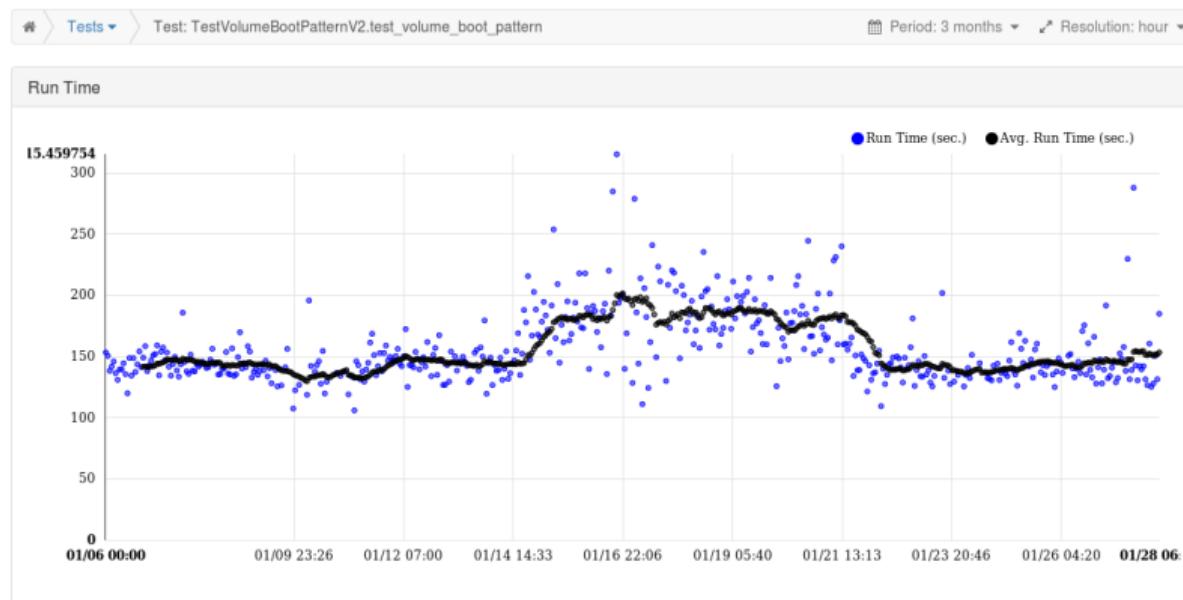
## Data Driven Decision Making

- ▶ Determine when it's time to skip a test
- ▶ Identify tests that are actually catching bugs
- ▶ Determine if failures are isolated to region, config, etc.

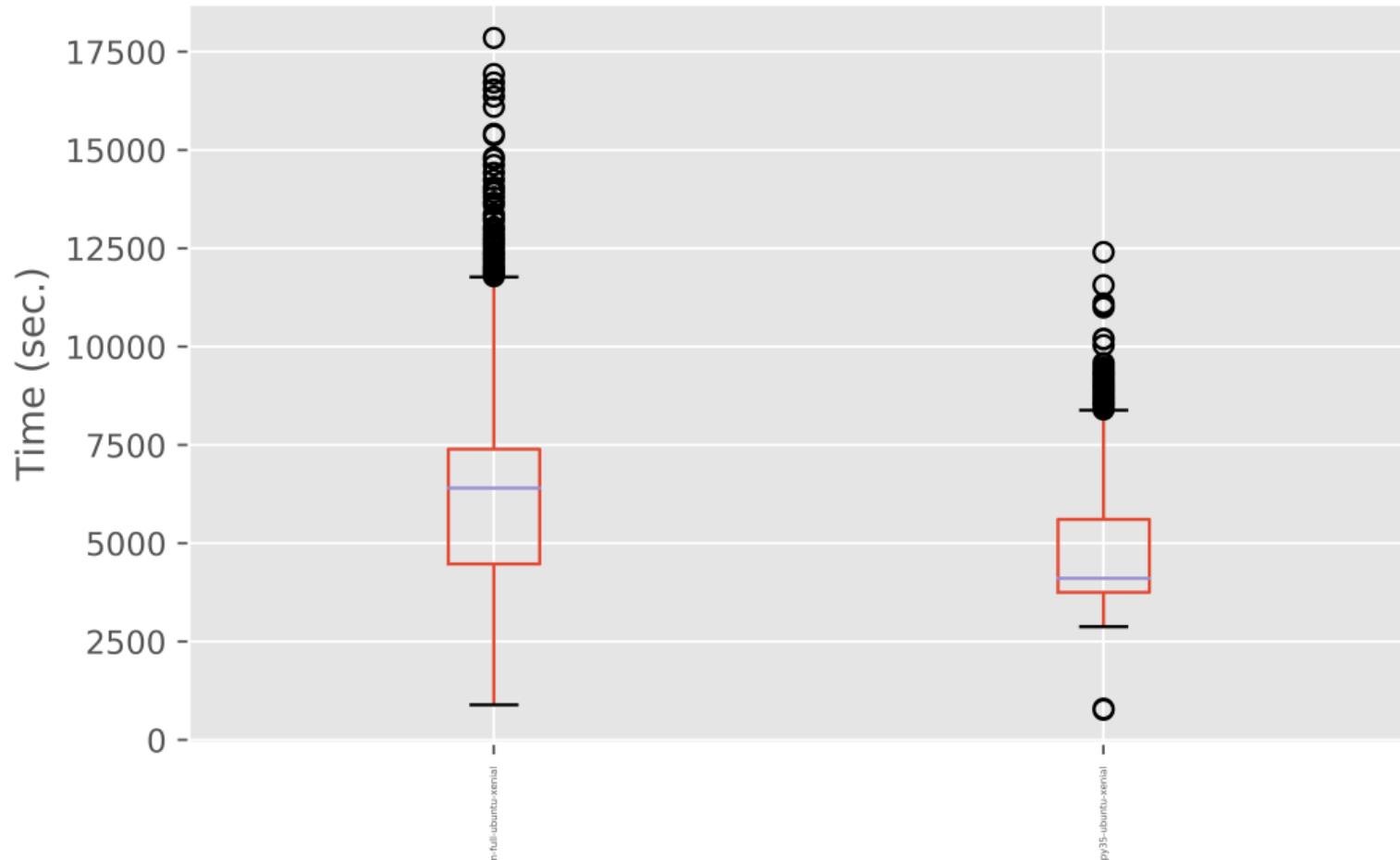
# Finding trends amongst the noise

- ▶ Catch performance regressions
- ▶ Identify relational trends in the data
- ▶ Find and identify non-deterministic bug/race conditions

TestVolumeBootPatternV2.test\_volume\_boot\_pattern



## Python 2.7 vs Python 3.5



## Issues

- ▶ Too many varied data sources each with unique limitations:
  - ▶ Only Gate and Periodic Job data (subunit2sql)
  - ▶ No views for infra failure (subunit2sql)
  - ▶ Limited to 1 line for searching (Elastic Search)
- ▶ Limited contribution in this space

## Future work

- ▶ Integrate all the things in openstack-health
- ▶ Use the data to optimize our test runner scheduler
- ▶ Enable automation around failure detection

## Where to get more information

- ▶ openstack-dev ML [openstack-dev@lists.openstack.org](mailto:openstack-dev@lists.openstack.org)
- ▶ #openstack-qa on Freenode
- ▶ <http://git.openstack.org/cgit/openstack/openstack-health/>
- ▶ <http://git.openstack.org/cgit/openstack-infra/subunit2sql>
- ▶ <http://git.openstack.org/cgit/openstack-infra/elastic-recheck/>

Questions?