

Including mutation testing as part of a continuous integration workflow

Tim Waterson

Supervisor: Louis Rose

What is mutation testing?

Mutation testing measures the effectiveness of a program's test suite.

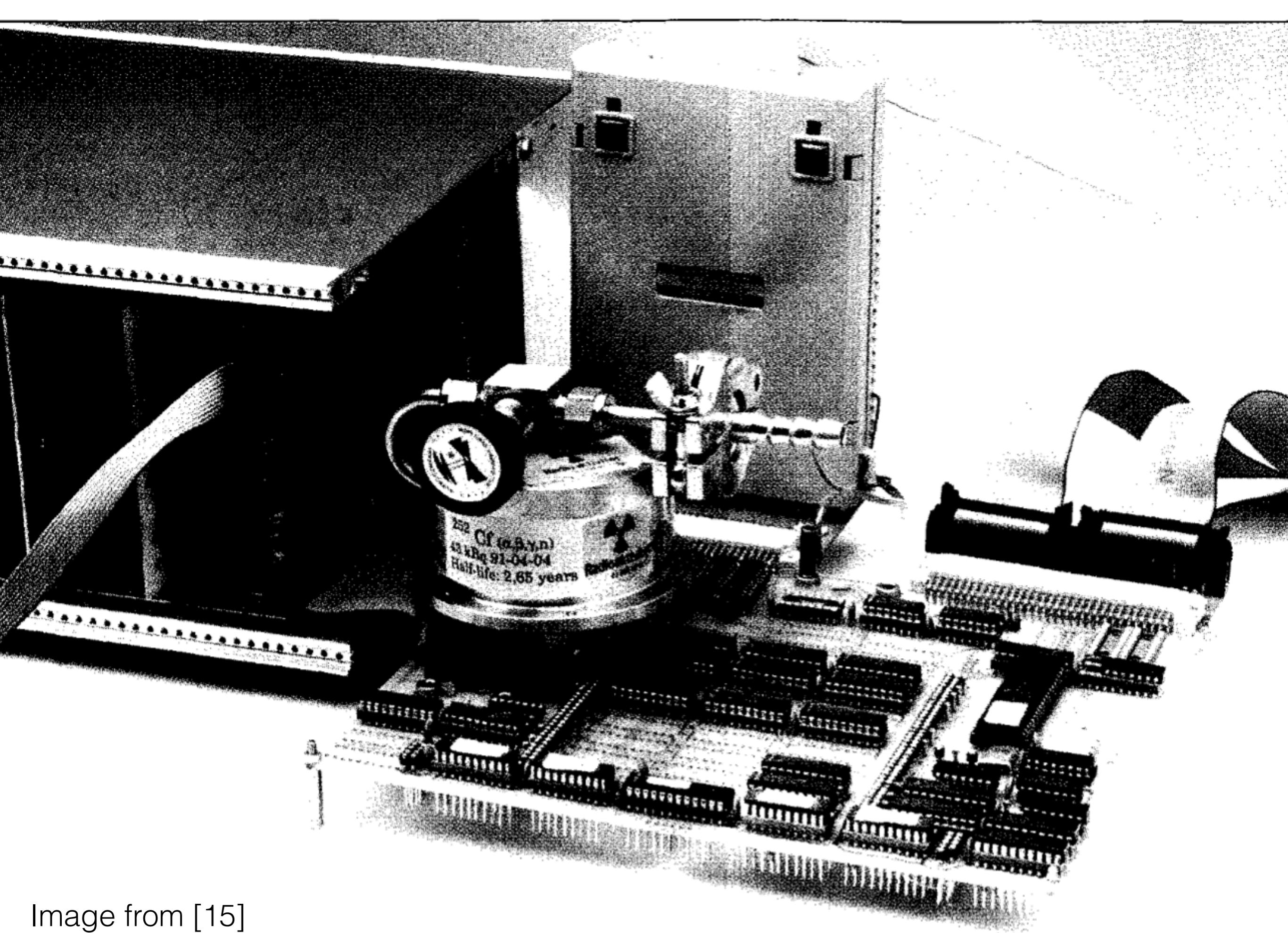
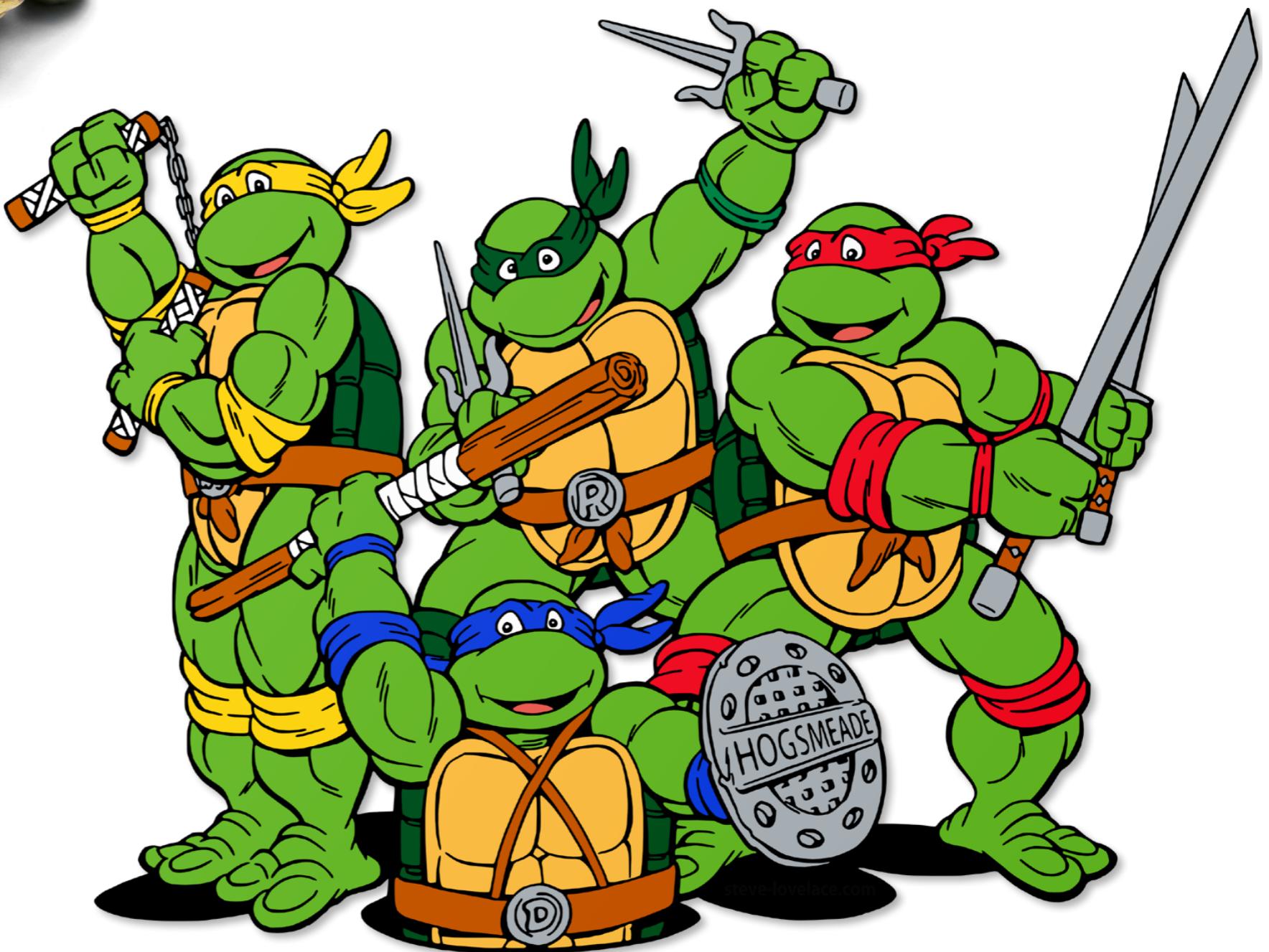


Image from [15]



Images from Wikimedia
Commons and Cliparts.co

A high mutation score is strongly correlated with test suite effectiveness.

What is continuous integration?

mutiny/mutiny - Travis CI Tim

<https://travis-ci.org/mutiny/mutiny>

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mutiny / mutiny

build failing

Current Branches Build History Pull Requests More options

✓ master Prepare v0.3.0

Commit c49ee68 Compare 28b52dc..c49ee68 Louis Rose authored and committed

⌚ #112 passed Elapsed time 1 min 22 sec about a month ago

Raw log

```
1 Worker information
2 Build system information
3
4 $ export DEBIAN_FRONTEND=noninteractive
5 $ git clone --depth=50 --branch=master https://github.com/mutiny/mutiny.git mutiny/mutiny
6 $ rvm use 2.2.3 --install --binary --fuzzy
7 $ export BUNDLE_GEMFILE=$PWD/Gemfile
8 $ ruby --version
9 ruby 2.2.3p173 (2015-08-18 revision 51636) [x86_64-linux]
10 $ rvm --version
11 rvm 1.26.10 (1.26.10) by Wayne E. Seguin <wayneeseguin@gmail.com>, Michal Papis <mpapis@gmail.com> [https://rvm.io/]
12 $ bundle --version
```



Image from [31]

Bringing the two concepts together

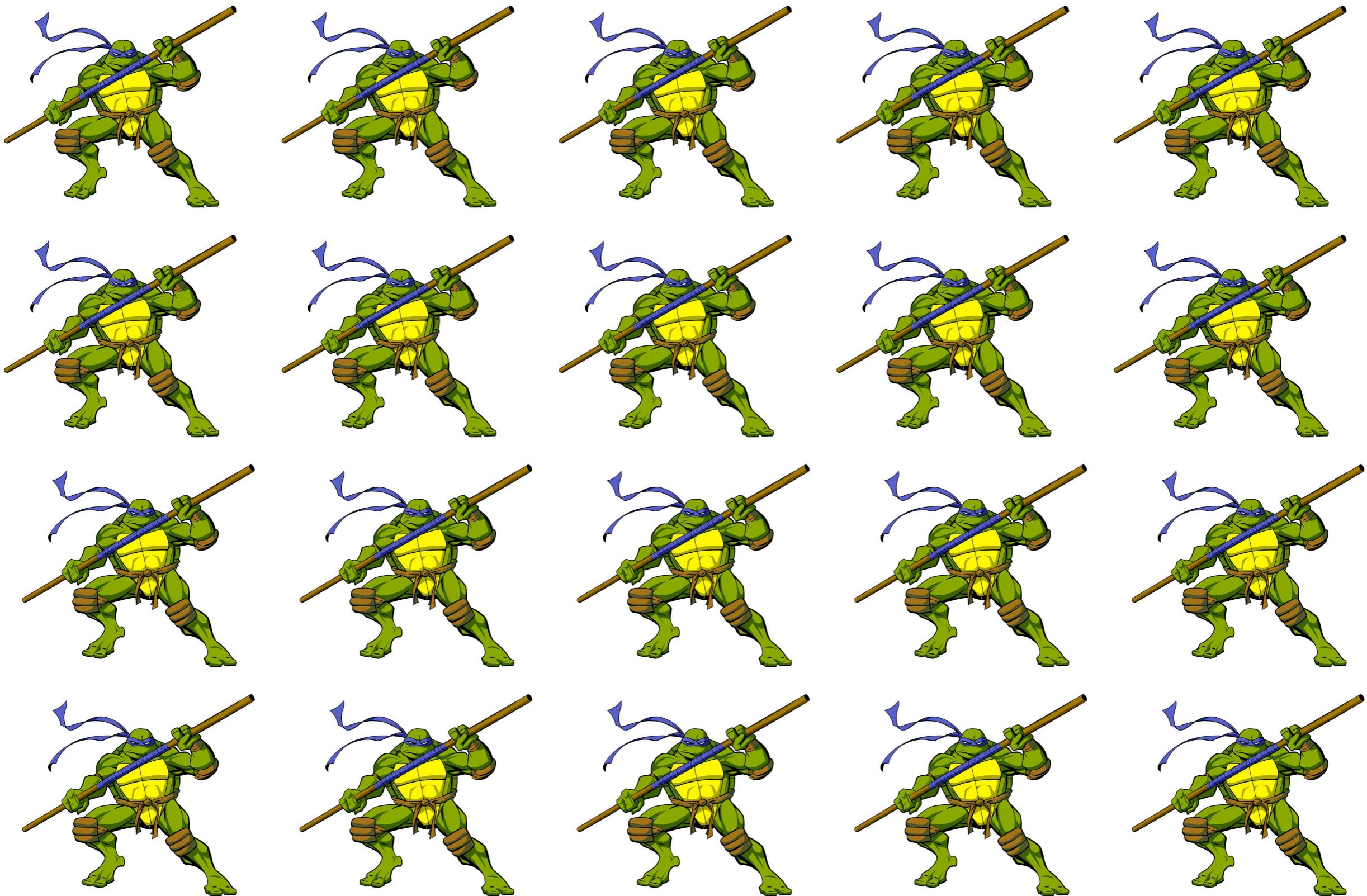


Continuous integration



CI builds need to be fast.

Mutation testing is slow.



CI builds need to either pass or fail.

Mutation testing produces a percentage score.

“All respectable software engineering research
should have the eventual goal of helping real
programmers build better software”

–Jeff Offutt

Analysis

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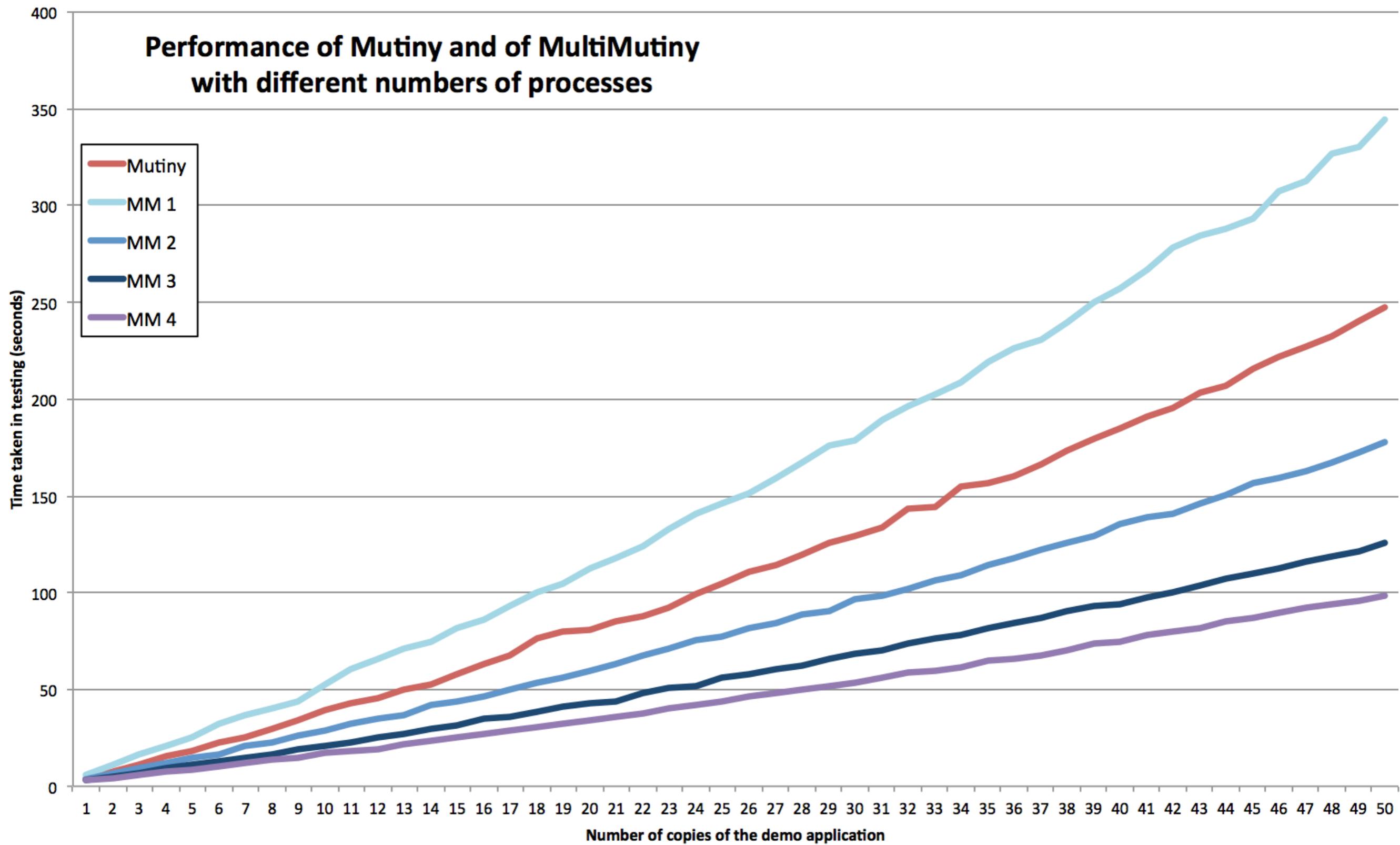
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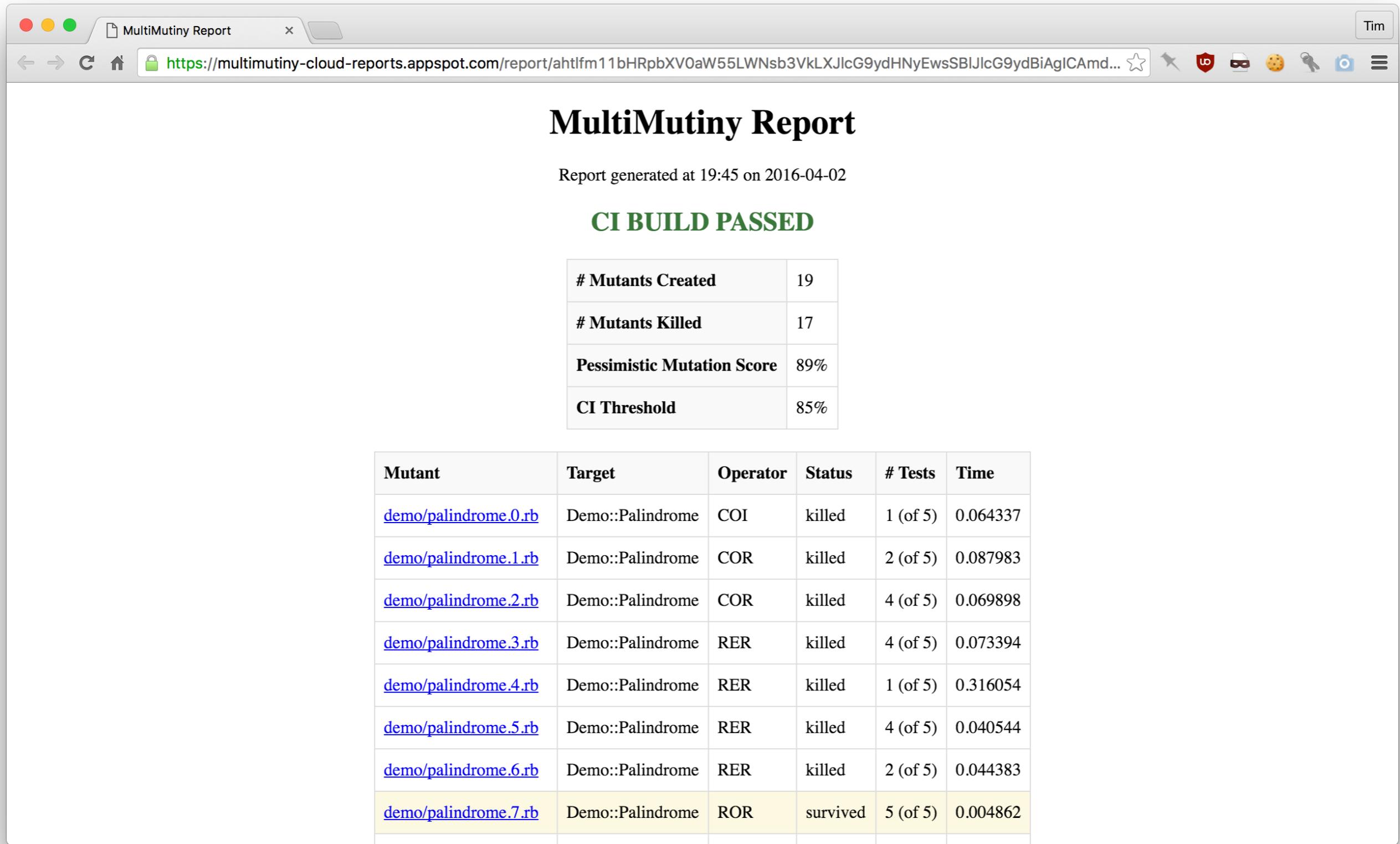
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Performance of Mutiny and of MultiMutiny with different numbers of processes



Design & Implementation

MultiMutiny	https://github.com/timw6n/multimutiny	468 lines of code
MultiMutiny Cloud Reports	https://github.com/timw6n/mm-cloud-reports	222 lines of code



A screenshot of a web browser window titled "MultiMutiny Report". The URL in the address bar is <https://multimutiny-cloud-reports.appspot.com/report/ahtlfm11bHRpbXV0aW55LWNsb3VkLXJlcG9ydHNyEwsSBIJlcG9ydBiAgICAmd...>. The main content of the page is a "MultiMutiny Report" generated at 19:45 on 2016-04-02. A green banner at the top says "CI BUILD PASSED". Below it is a table with four rows:

# Mutants Created	19
# Mutants Killed	17
Pessimistic Mutation Score	89%
CI Threshold	85%

Below the table is a larger table showing the results for each mutant. The columns are: Mutant, Target, Operator, Status, # Tests, and Time. The rows are:

Mutant	Target	Operator	Status	# Tests	Time
demo/palindrome.0.rb	Demo::Palindrome	COI	killed	1 (of 5)	0.064337
demo/palindrome.1.rb	Demo::Palindrome	COR	killed	2 (of 5)	0.087983
demo/palindrome.2.rb	Demo::Palindrome	COR	killed	4 (of 5)	0.069898
demo/palindrome.3.rb	Demo::Palindrome	RER	killed	4 (of 5)	0.073394
demo/palindrome.4.rb	Demo::Palindrome	RER	killed	1 (of 5)	0.316054
demo/palindrome.5.rb	Demo::Palindrome	RER	killed	4 (of 5)	0.040544
demo/palindrome.6.rb	Demo::Palindrome	RER	killed	2 (of 5)	0.044383
demo/palindrome.7.rb	Demo::Palindrome	ROR	survived	5 (of 5)	0.004862

MultiMutiny
core code

Mutation tool
(wrapper class)

Scorer

Reporters



Evaluation

Project	GitHub repository	Description (from GitHub)
event_bus	kevinrutherford/event_bus	A simple pubsub event bus.
full_name	agilidee/full_name	Adds <code>full_name</code> method for classes that provide a <code>first_name</code> and a <code>last_name!</code>
lumberjack	bdurand/lumberjack	A simple, powerful, and very fast logging utility that can be a drop in replacement for <code>Logger</code> or <code>ActiveSupport::BufferedLogger</code> .

It works!



Project	Mutants generated	Mutants killed	Pessimistic mutation score
event_bus	57	51	89%
full_name	51	51	100%
lumberjack	565	480	85%

And it's fast!



Project	Mutiny	MultiMutiny	MultiMutiny as a % of Mutiny
event_bus	17.32s	7.20s	41.59%
full_name	15.30s	6.55s	42.79%
lumberjack	142.68s	51.78s	36.29%

Conclusion & Further Work

Any Questions?

All square-bracketed references refer to items in the main project Bibliography.