Karlsruhe Institute of Technology

Ginkgo

How do we make sure our code does not get worse?

Towards Continuous Benchmarking (CB)

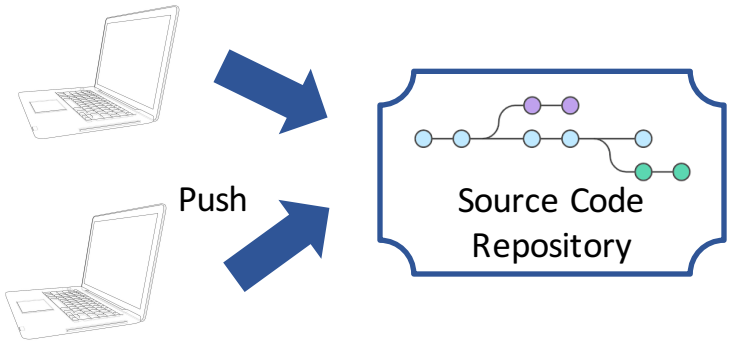
GridKa School 2019 – The Art of Data
August 26th-30th, 2019 | Karlsruhe, Germany

Hartwig Anzt, Terry Cojean, Goran Flegar, Thomas Grützmacher, Pratik Nayak, Mike Tsai

A Healthy Software Development Cycle

Developer

A Healthy Software Development Cycle



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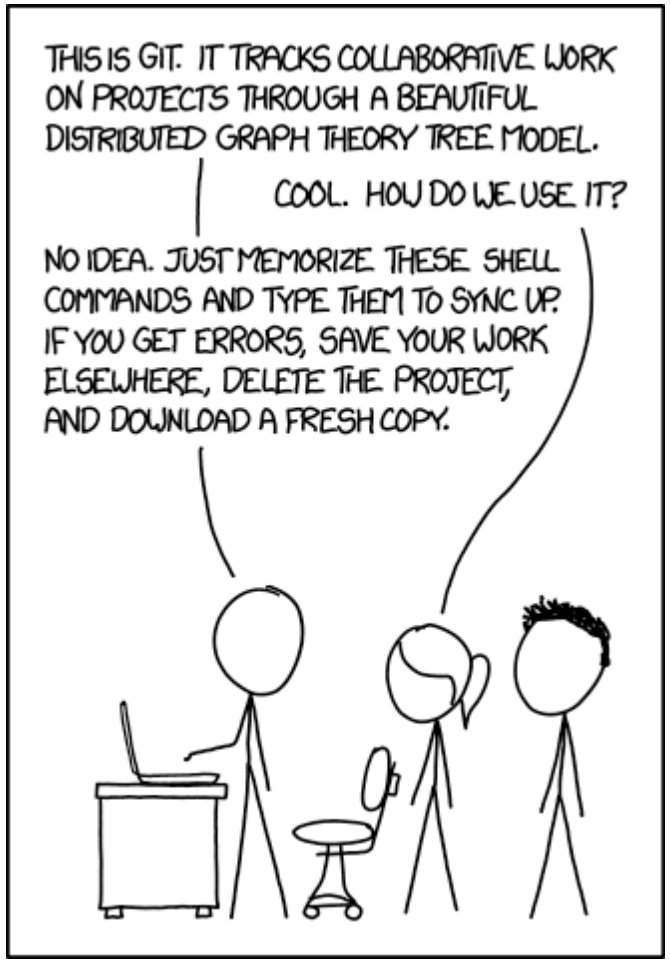

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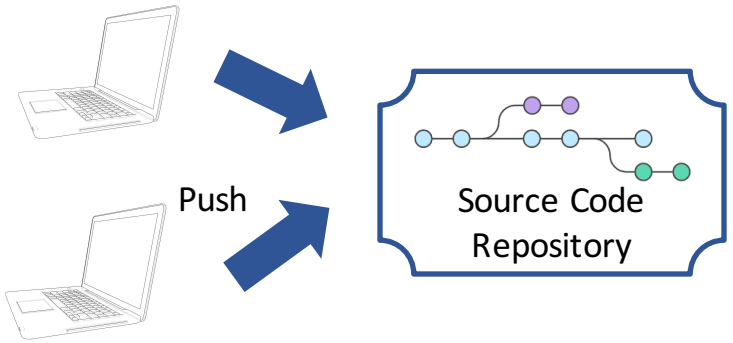

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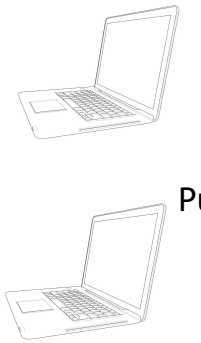

Developer

Push

Source Code Repository

CMake Cross-platform Make

CI Build

Continuous Integration (CI)

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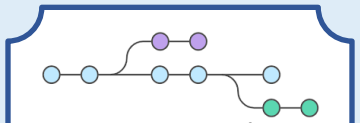

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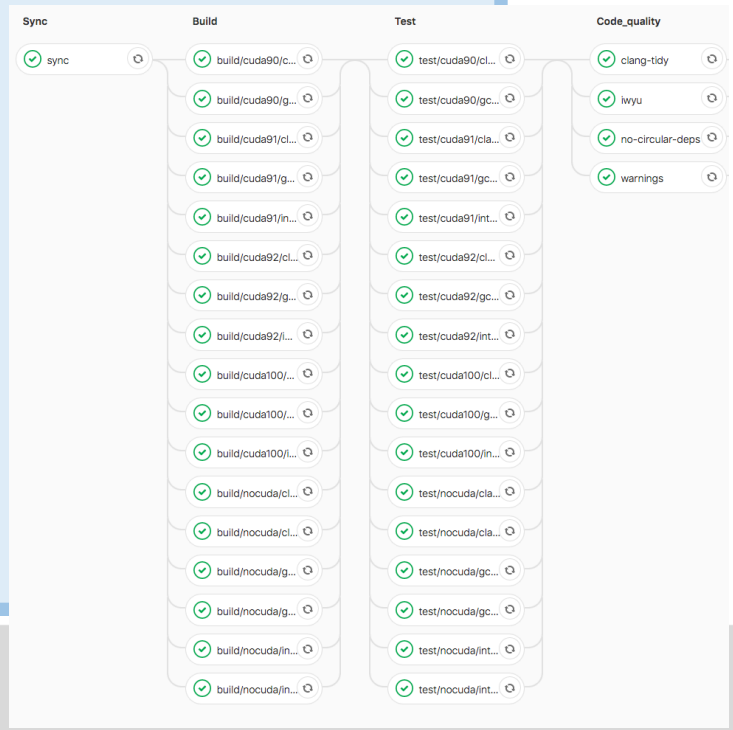

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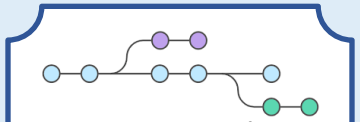

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Continuous 10 builds [view timeline]

		Configure		Build		Test				
Site	Build Name	Error	Warn	Error	Warn	Not Run	Fail	Pass	Start Time	Labels
Linux-FineCI	COVERAGE	0	9	0	13	0	0	103	1 hour ago	(none)
Linux-FineCI	COVERAGE	0	9	0	13	0	0	103	1 hour ago	(none)
Linux-FineCI	Valgrind	0	9	0	13				2 hours ago	(none)
Linux-FineCI	ASAN	0	5	0	1				2 hours ago	(none)
Linux-FineCI	TSAN	0	5	0	1				2 hours ago	(none)
Linux-FineCI	COVERAGE	0	9	0	13	0	0	103	2 hours ago	(none)
Linux-FineCI	ASAN	0	5	0	1				5 hours ago	(none)
Linux-FineCI	Valgrind	0	9	0	13				5 hours ago	(none)
Linux-FineCI	TSAN	0	5	0	1				5 hours ago	(none)
Linux-FineCI	COVERAGE	0	9	0	13	0	0	103	6 hours ago	(none)

Coverage

Site	Build Name	Percentage	LOC Tested	LOC Untested	Date	Labels
Linux-FineCI	COVERAGE	95.97%	6737	283	6 hours ago	(none)
Linux-FineCI	COVERAGE	95.97%	6737	283	2 hours ago	(none)
Linux-FineCI	COVERAGE	95.97%	6737	283	1 hour ago	(none)
Linux-FineCI	COVERAGE	95.97%	6737	283	1 hour ago	(none)

Dynamic Analysis

Site	Build Name	Checker	Defect Count	Date
Linux-FineCI	TSAN	ThreadSanitizer	3178	5 hours ago
Linux-FineCI	Valgrind	Valgrind	80	5 hours ago
Linux-FineCI	ASAN	AddressSanitizer	0	5 hours ago
Linux-FineCI	TSAN	ThreadSanitizer	3184	2 hours ago
Linux-FineCI	ASAN	AddressSanitizer	0	2 hours ago

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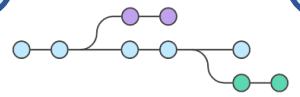

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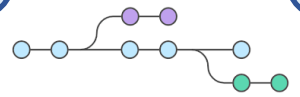

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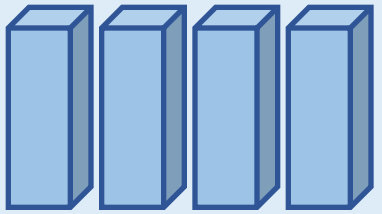
- Idea: Automated benchmark runs every time new code is added.

CI Benchmark Tests

Schedule in Batch System



HPC System

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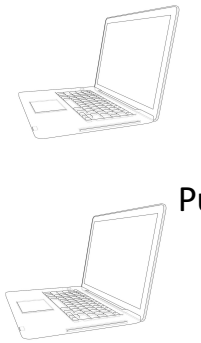

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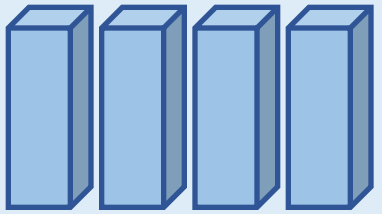

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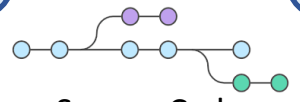

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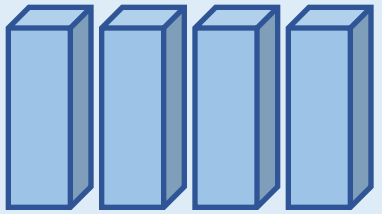

HPC System

Security Thrust!

- External code is run on HPC system
- Possible point of attack

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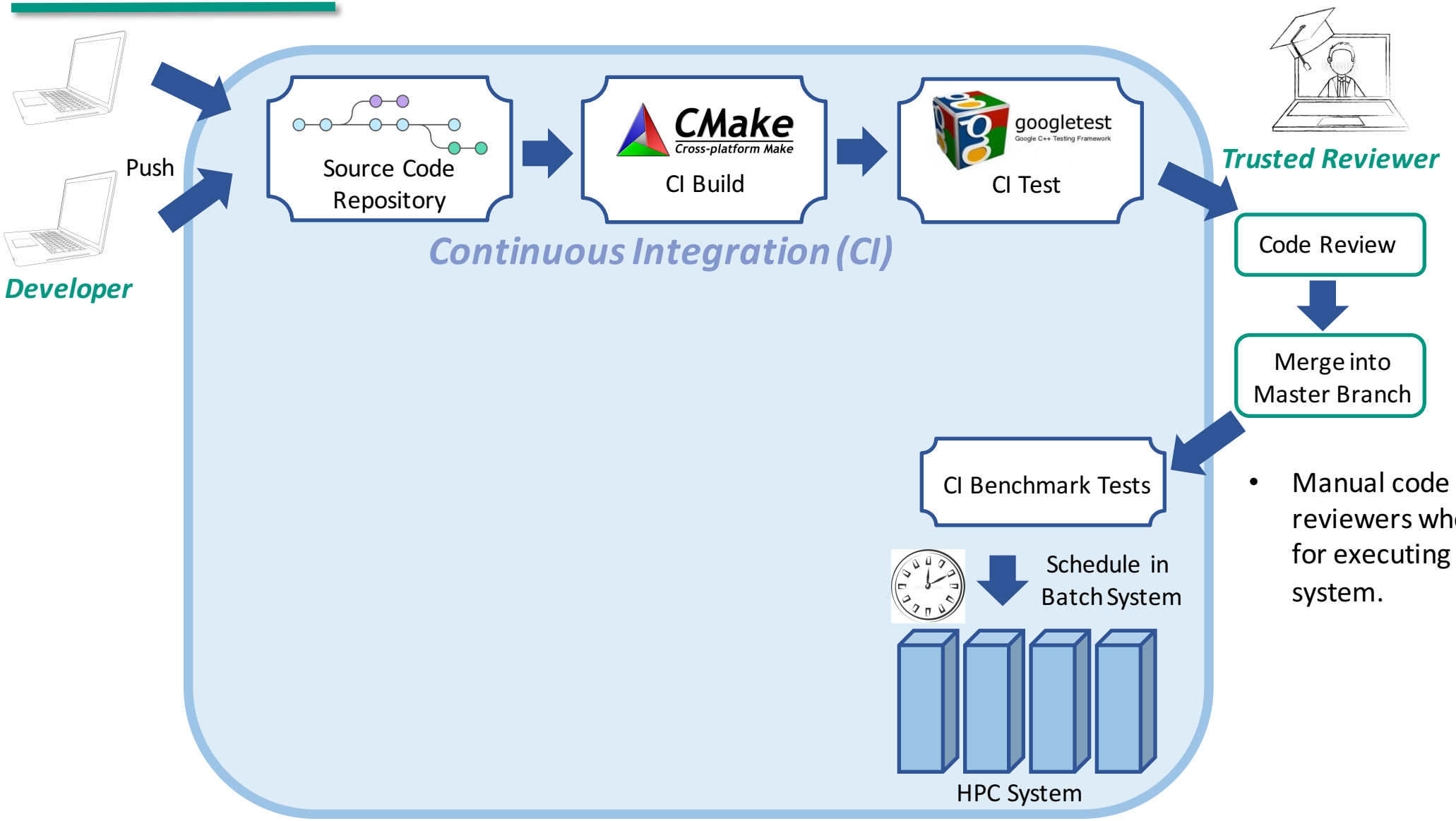

- Manual code reviews by trusted reviewers who take responsibility for executing code on the HPC system.

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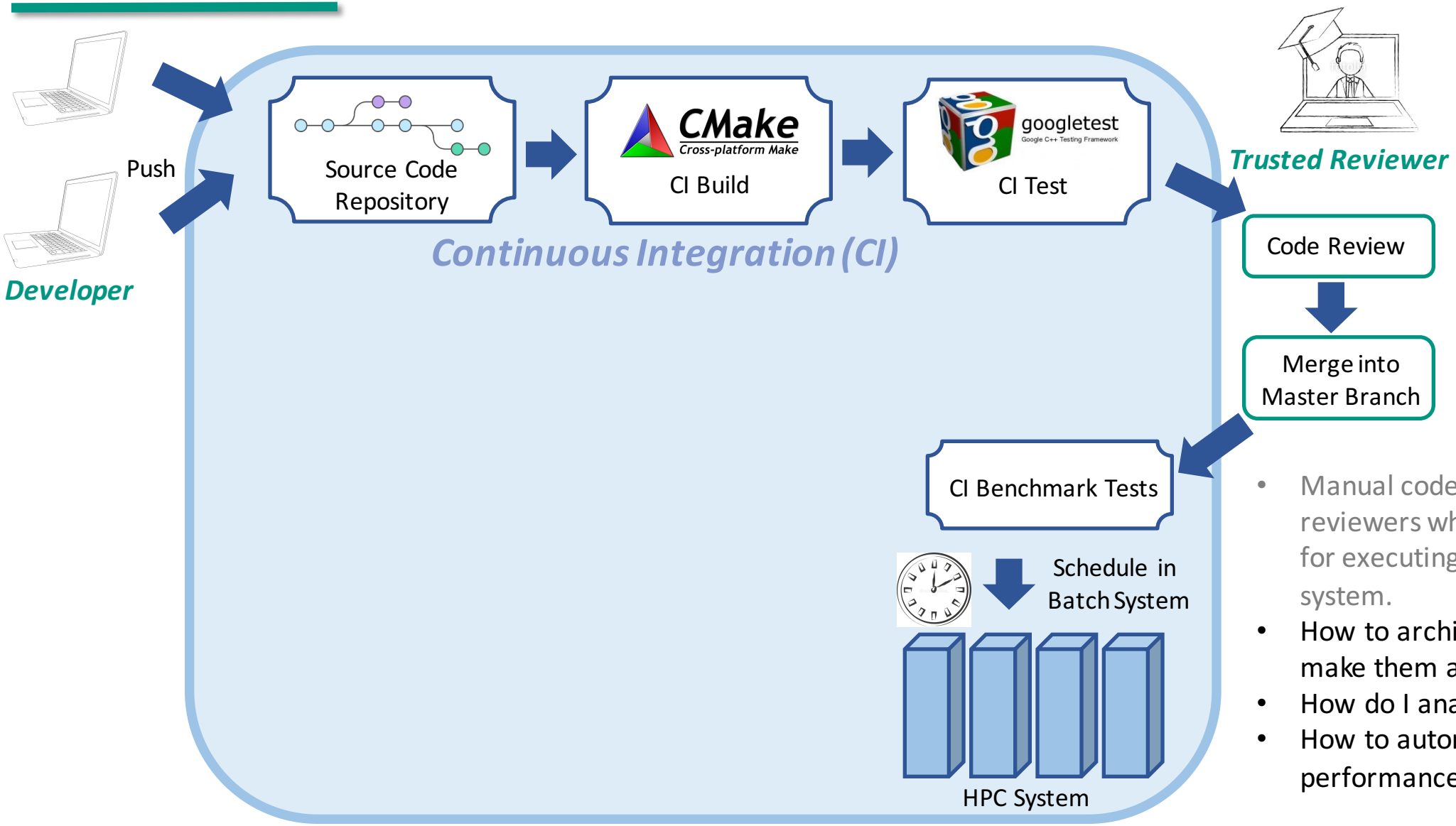

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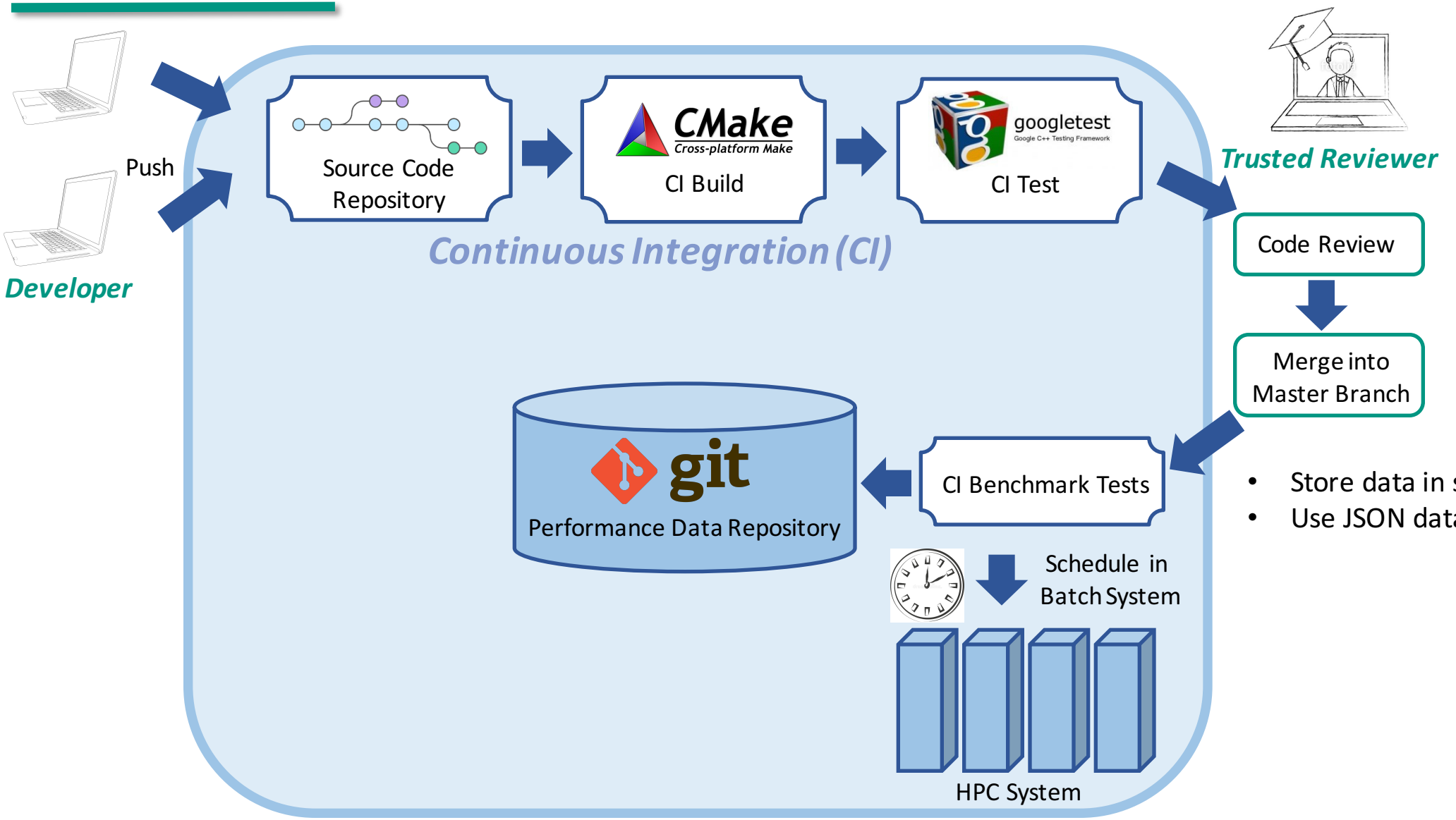
- How to archive the results and make them accessible?
- How do I analyze them?
- How to automatically detect performance degradations?

A Healthy Software Development Cycle



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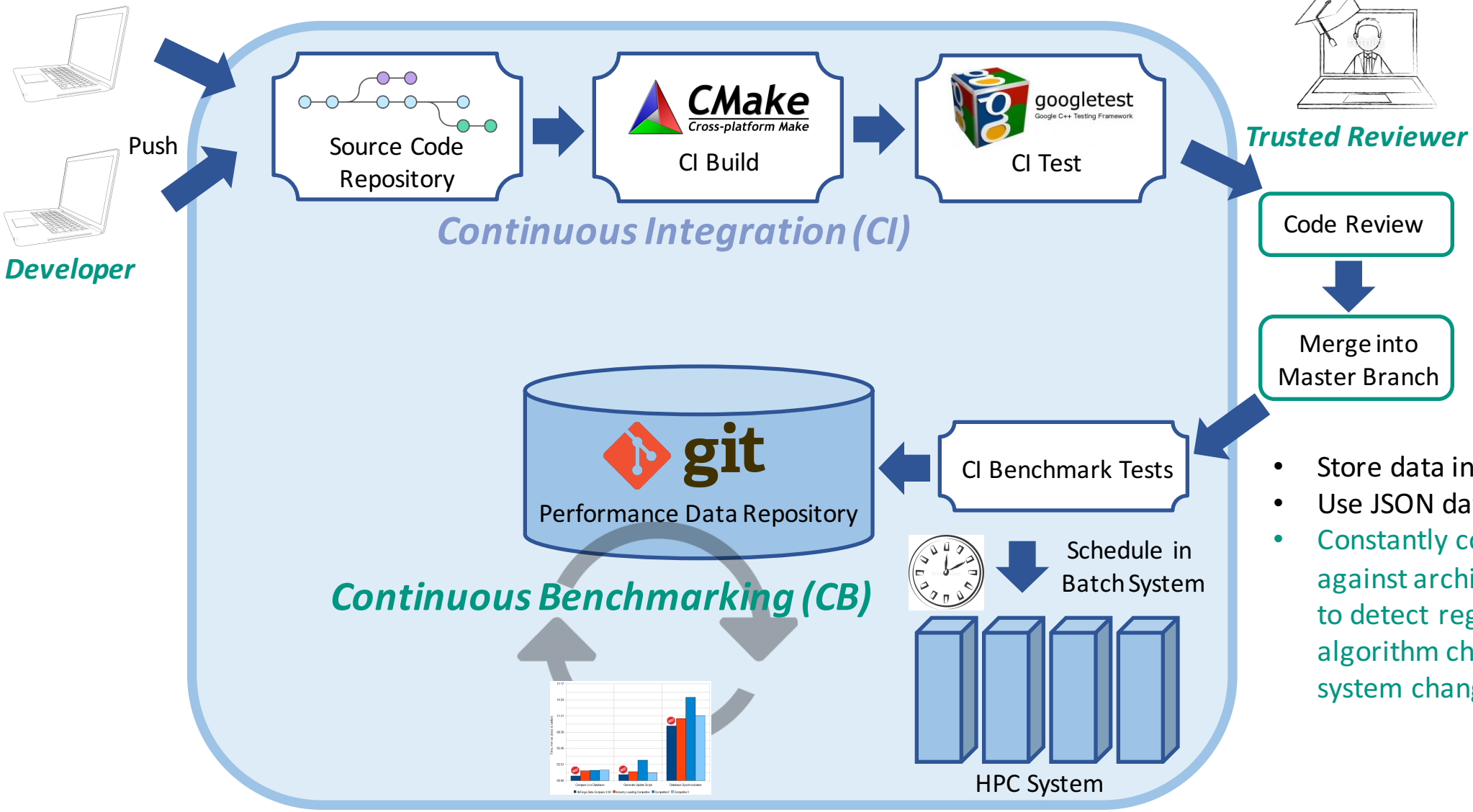

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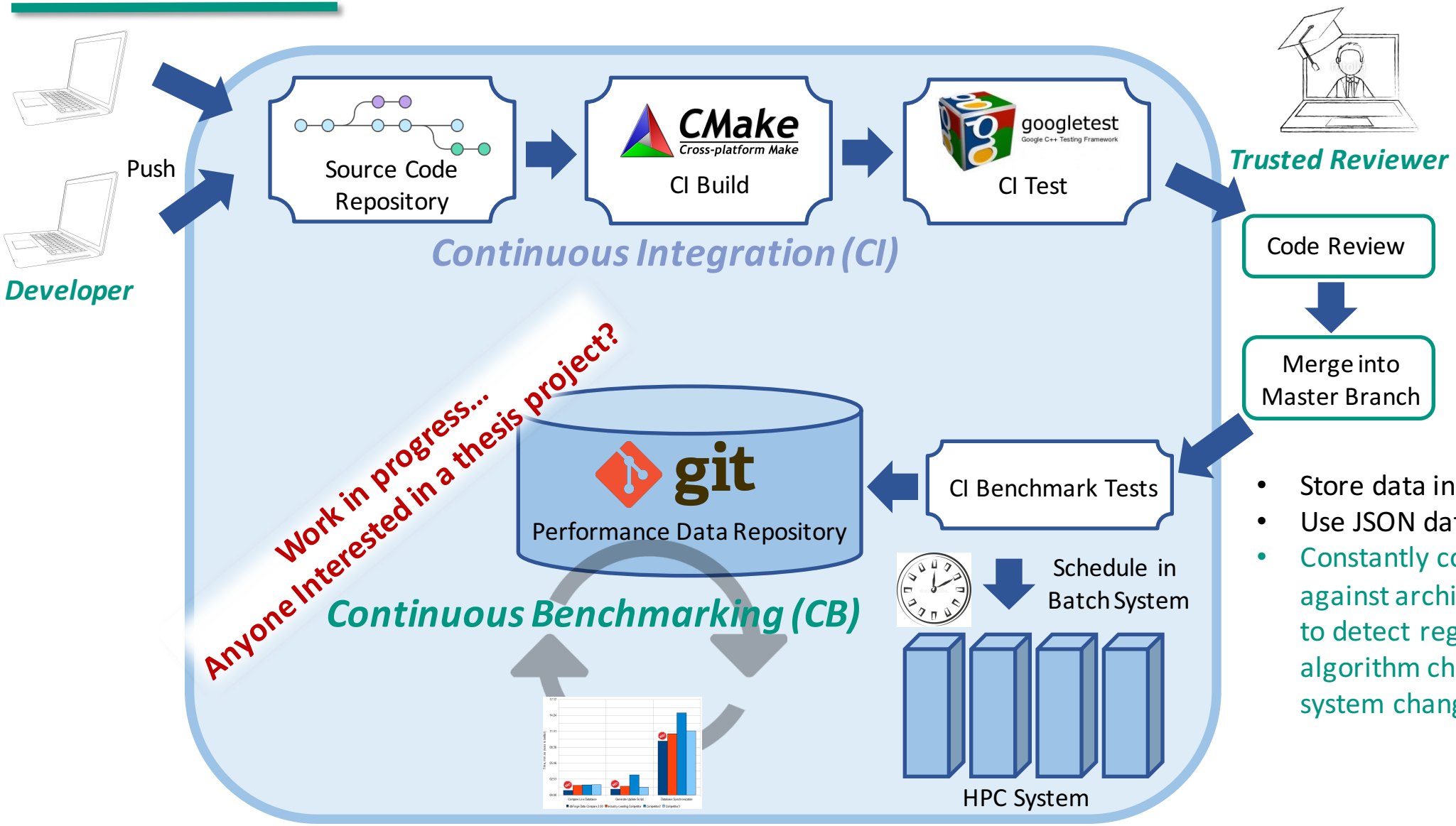

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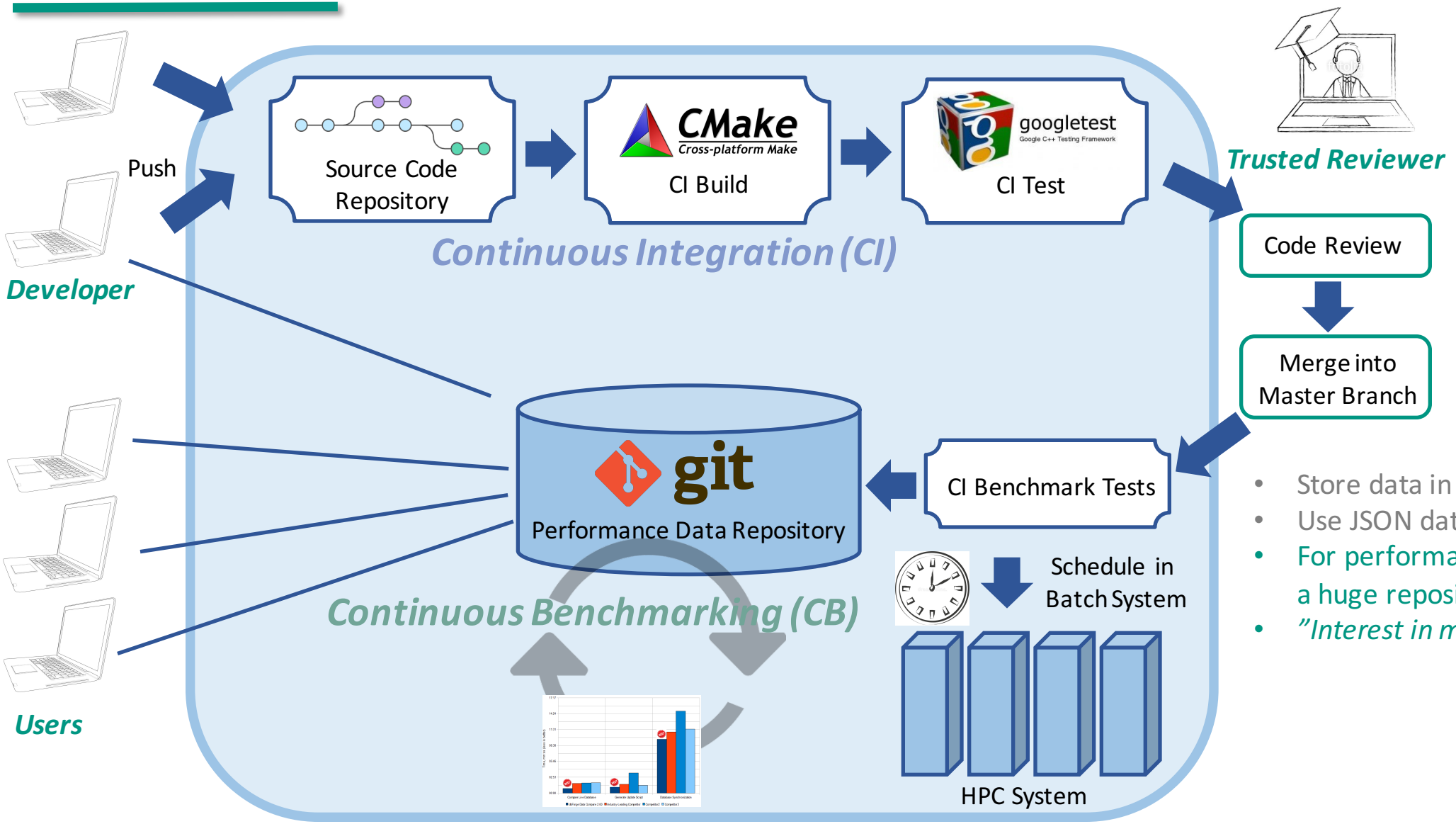

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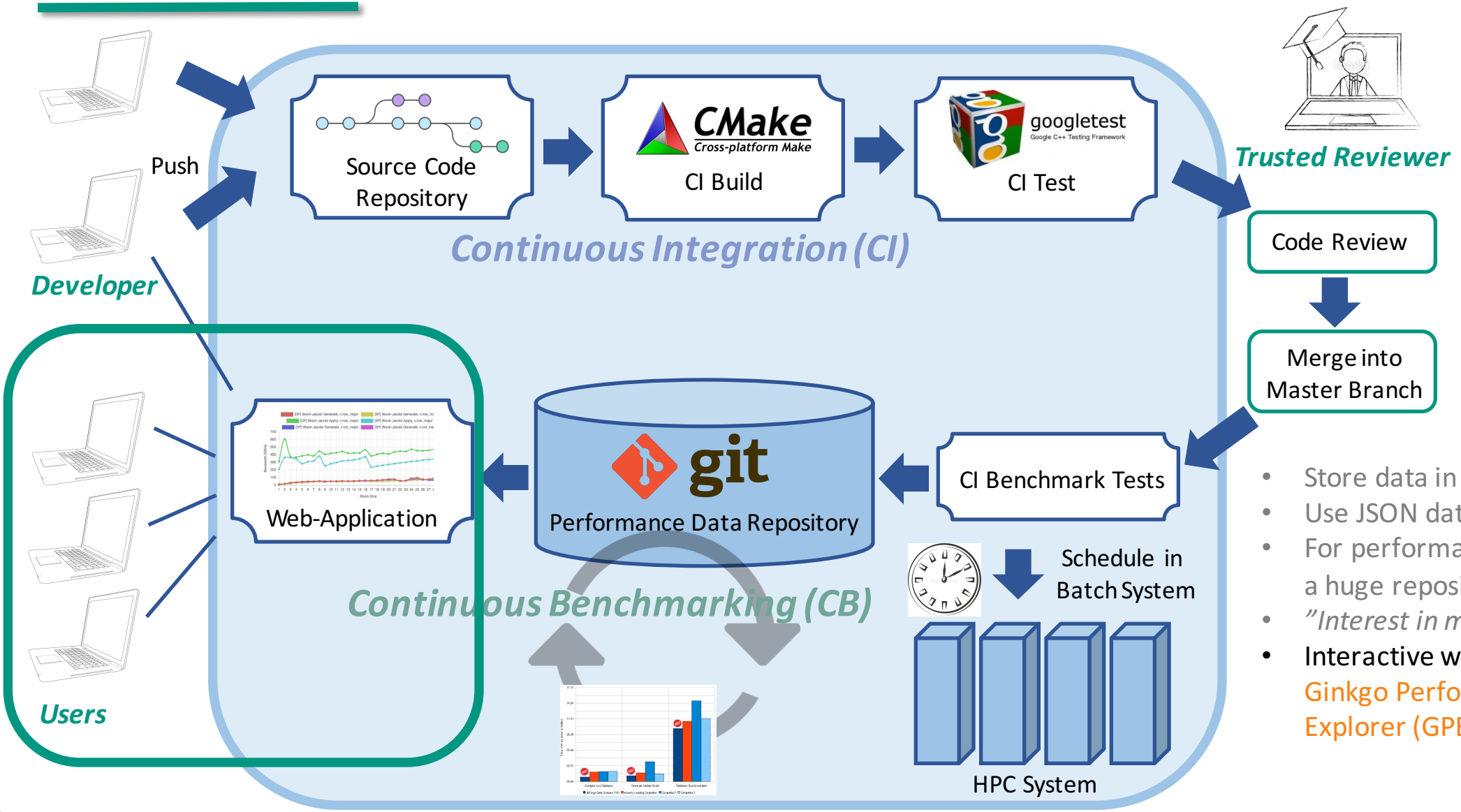

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GPE

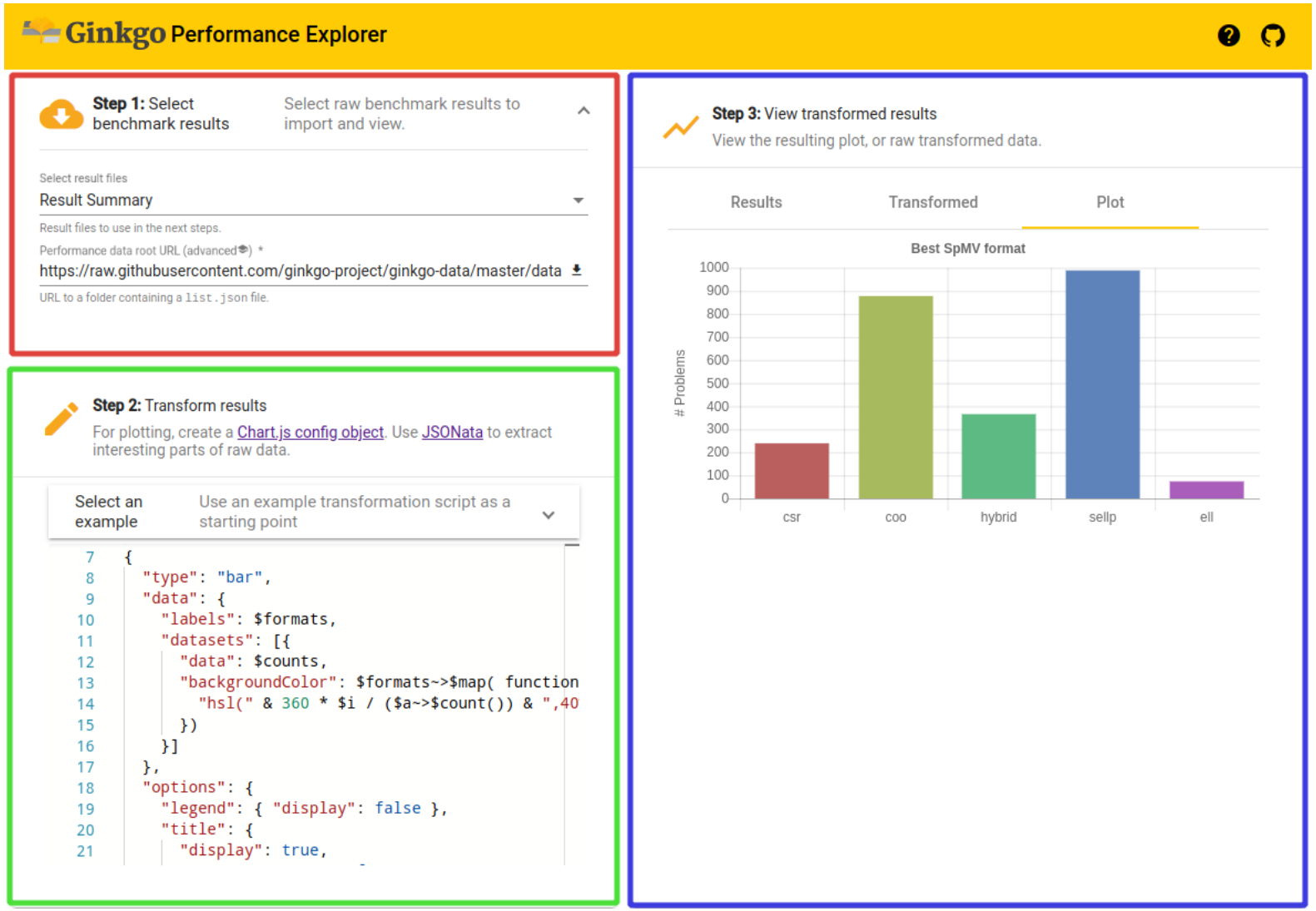
Ginkgo Performance Explorer (GPE)

Karlsruhe Institute of Technology

Data Selection Tab

Transformation Script Editor

Data and Plot Viewer



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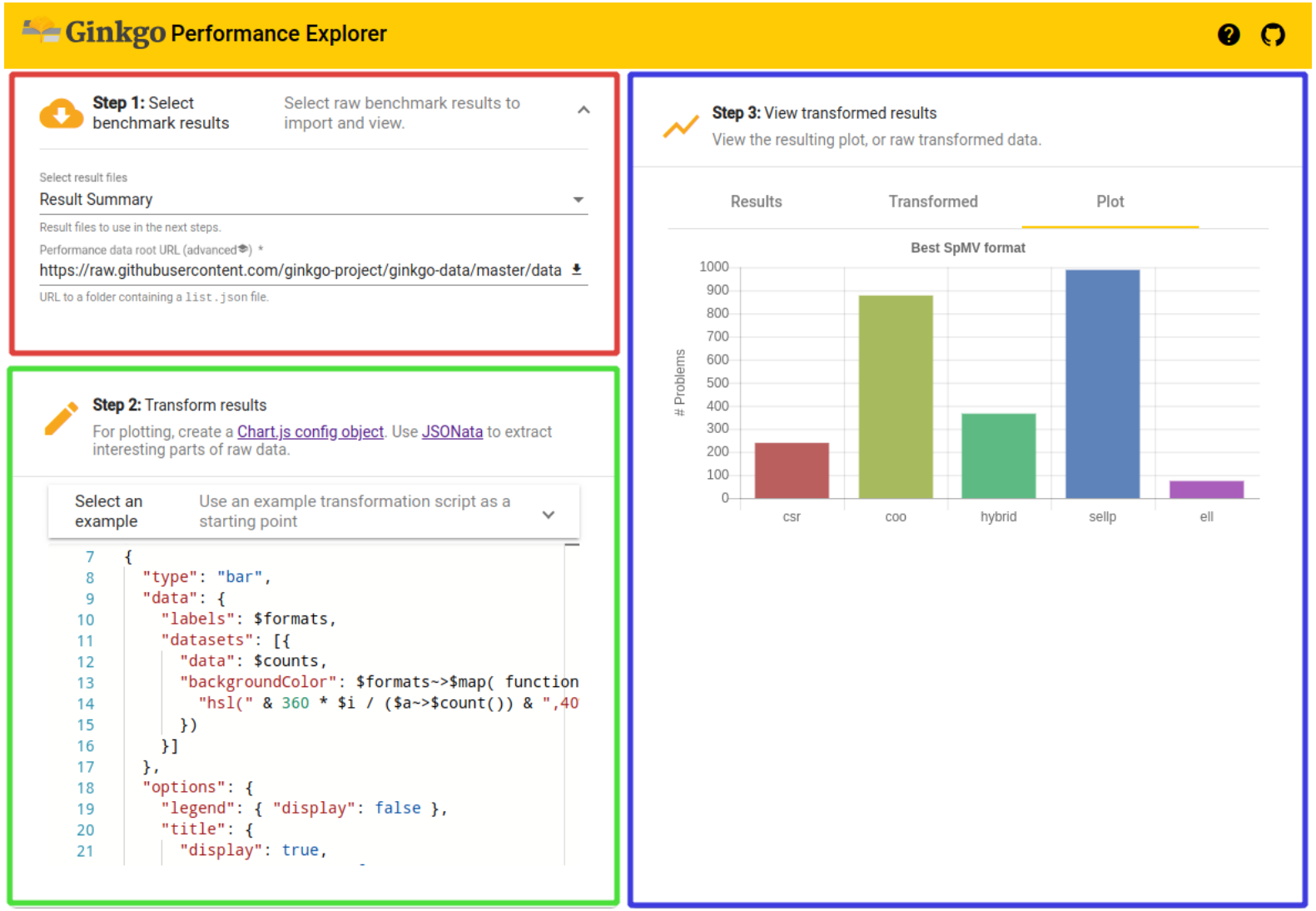

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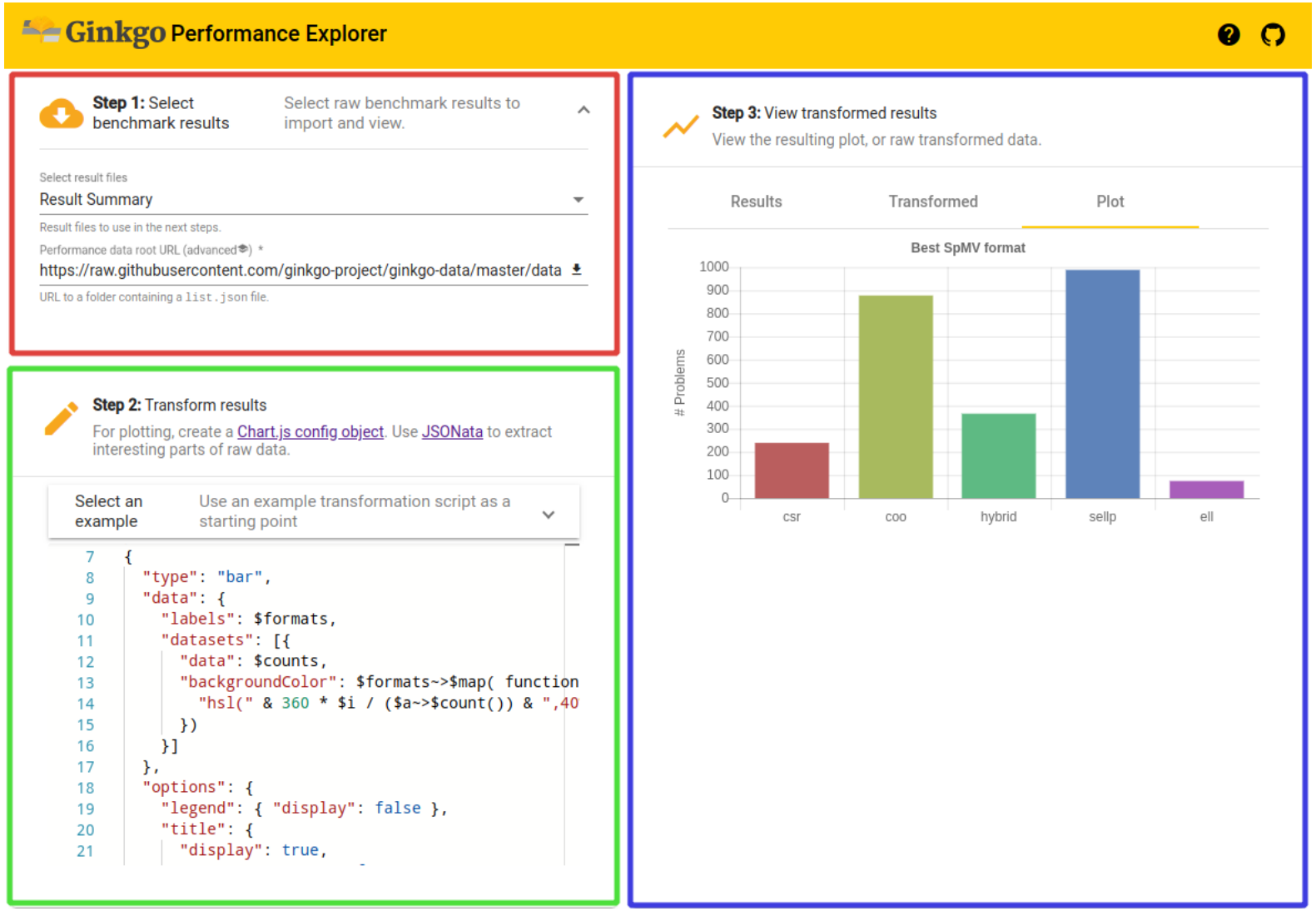

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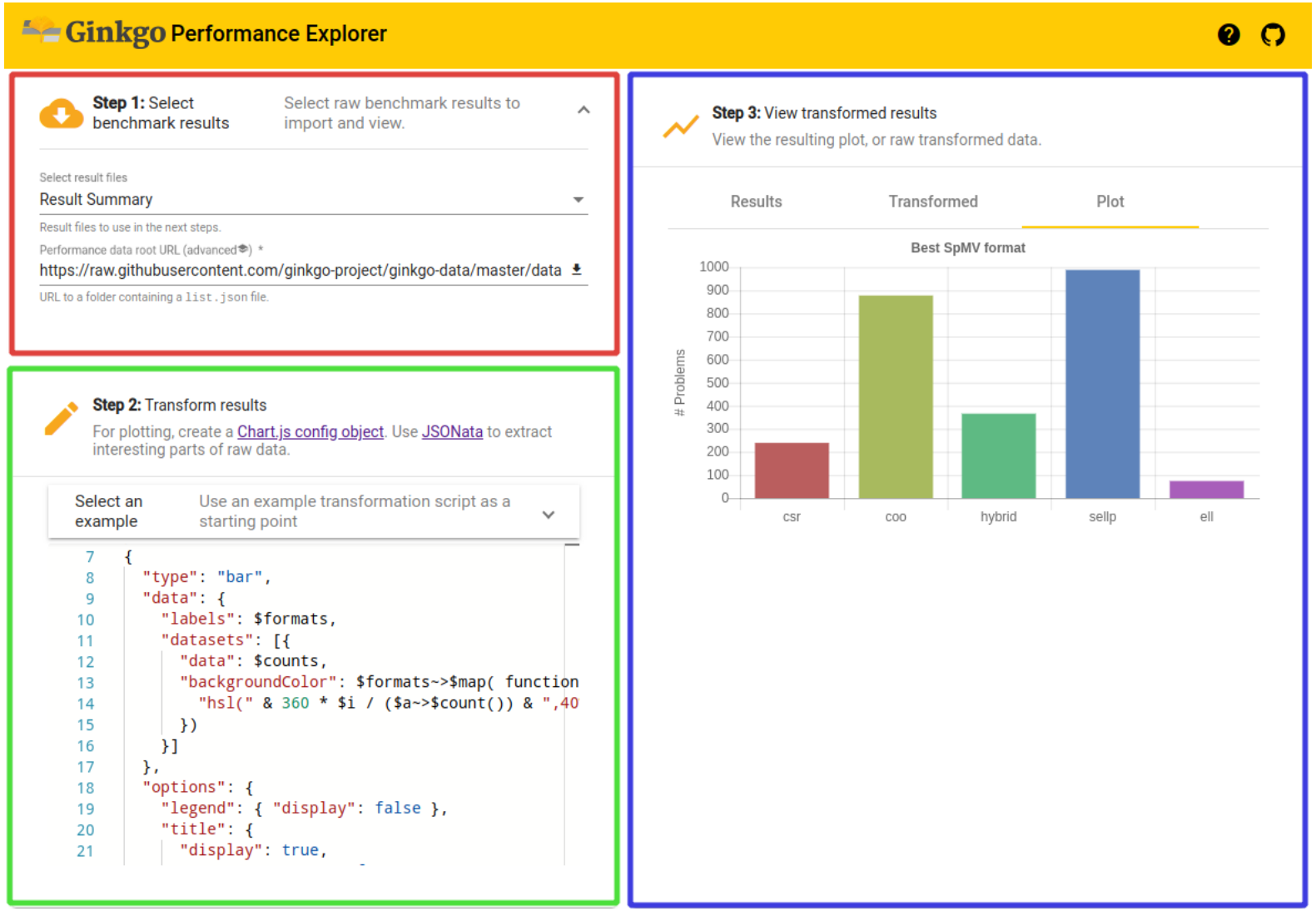


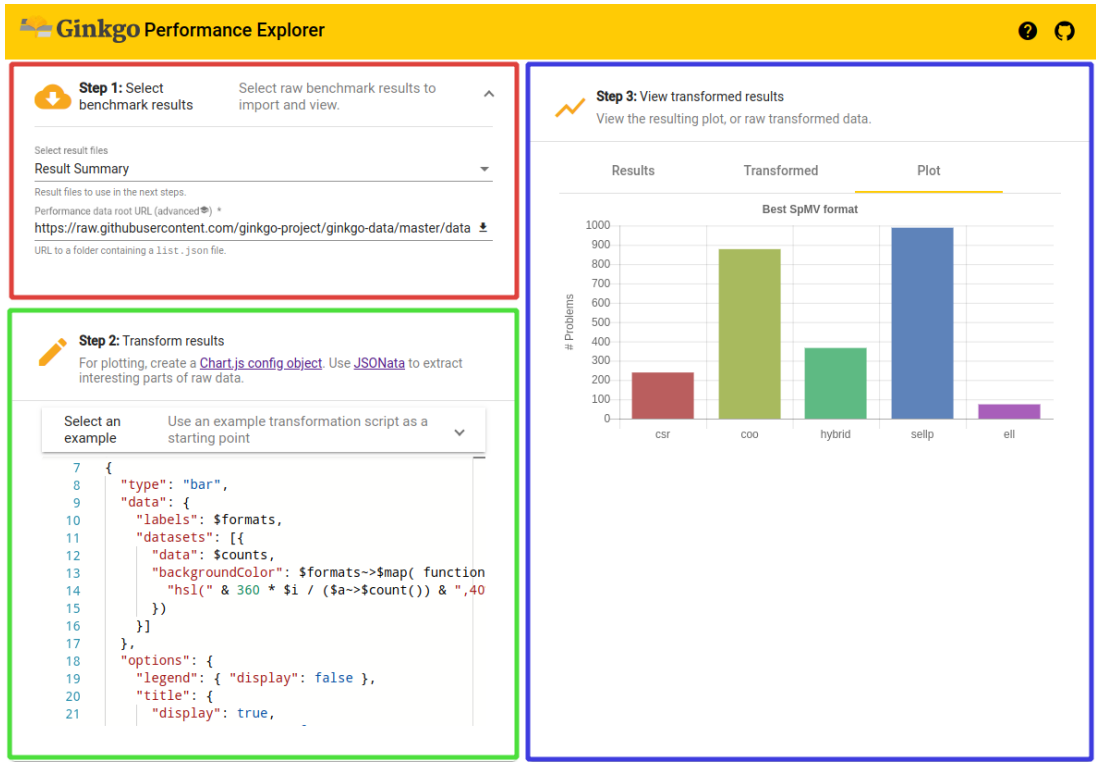
Data and Plot Viewer

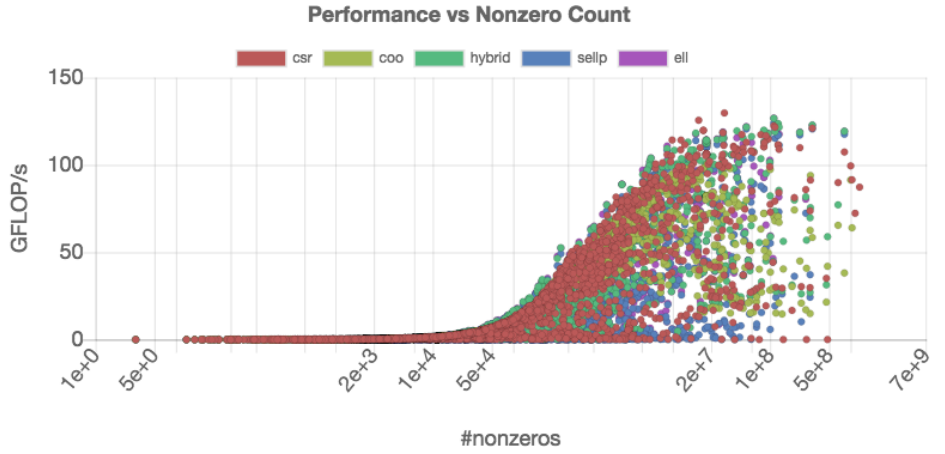
3.
Analyze data visually.

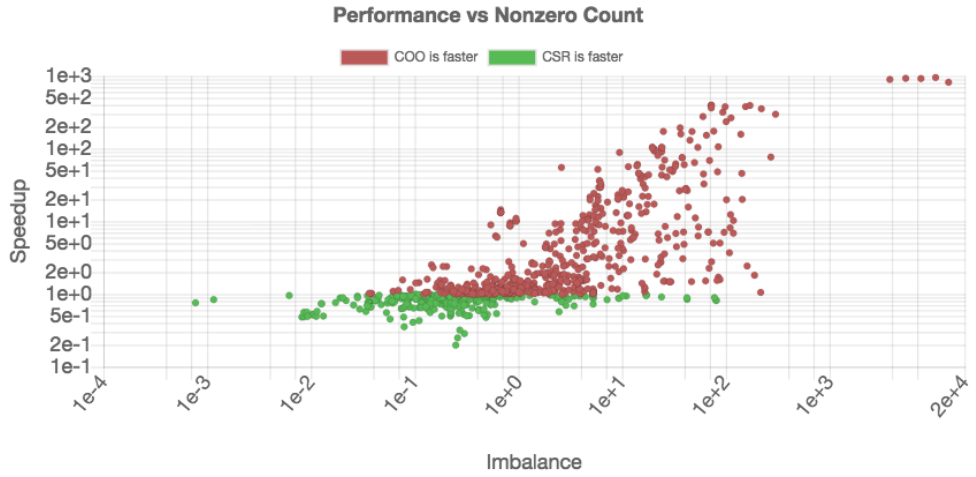
GPE

Ginkgo Performance Explorer (GPE)

Allows anyone to access & visualize Ginkgo Performance data in a browser.







https://ginkgo-project.github.io/gpe/

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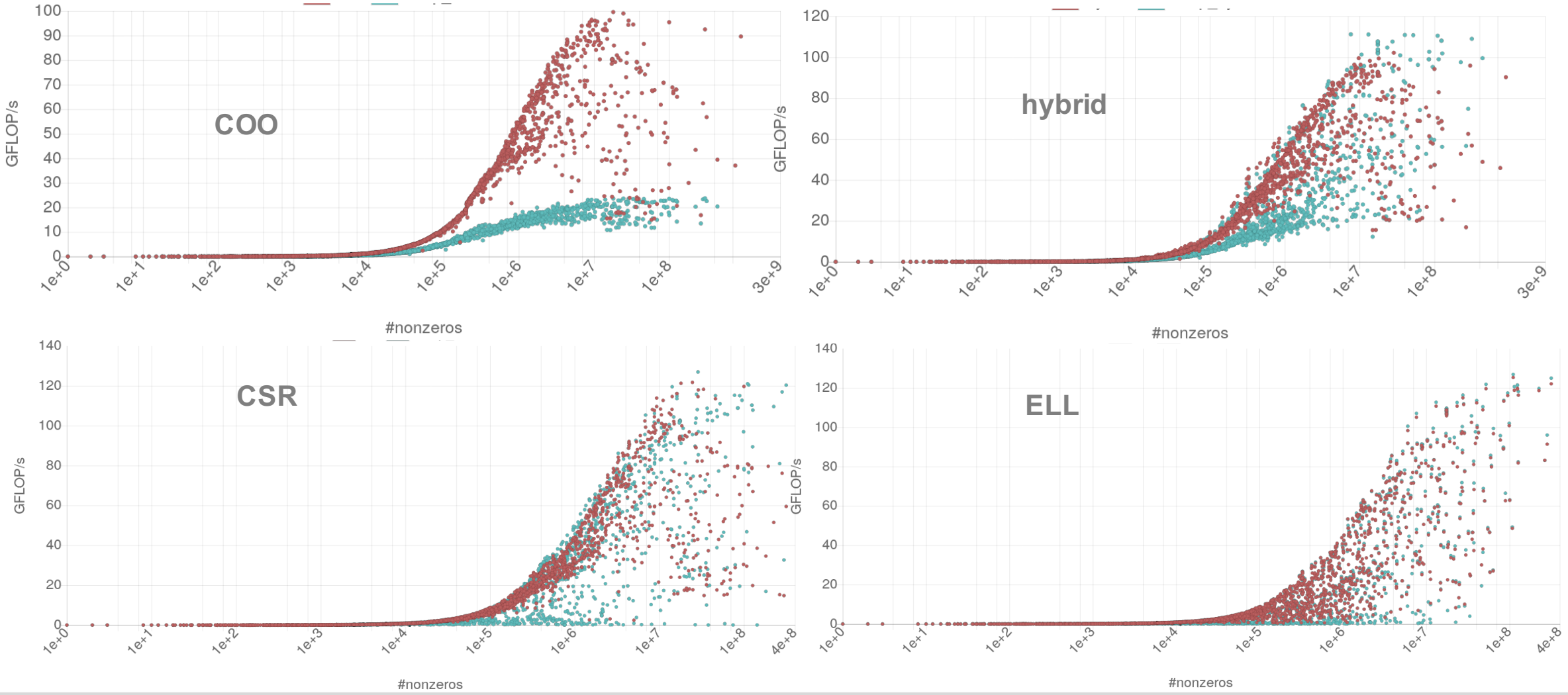
Data for 3,000 test matrices from SuiteSparse, sparse matrix vector product performance.



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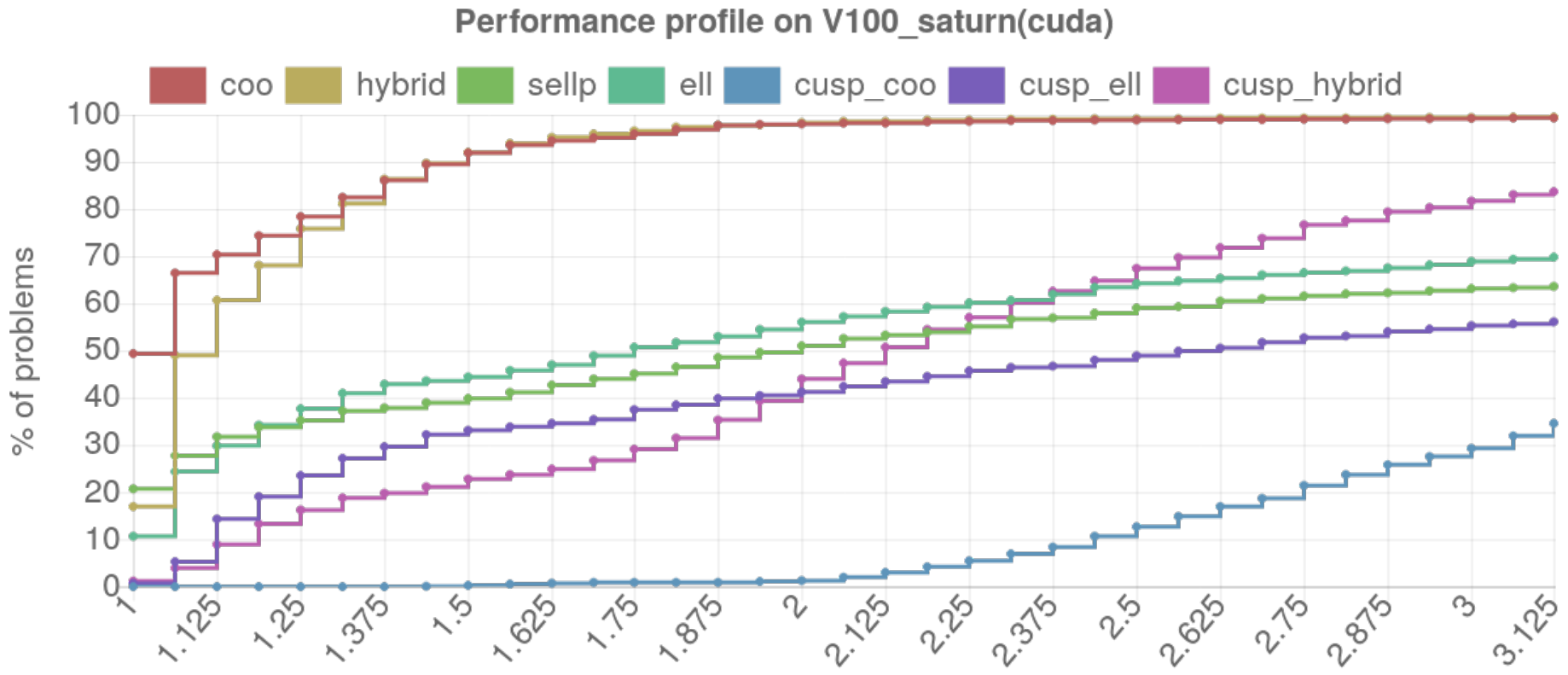

Dolan & More: Benchmarking optimization software with performance profiles

GPE

Summary

Continuous Benchmarking Benefits

https://bssw.io/

- Archiving performance data along with execution parameters ensures **full benchmark reproducibility**.
- **Comparing** the performance results over the code lifetime identifies **performance degradations**.
- **Ease of use**: the setup allows to launch benchmark with few clicks.

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Ginkgo Performance Explorer (GPE) Benefits

- The design of GPE efficiently realizes the analysis as **web service**, removing the need for downloading performance data to local disk or installing additional software.
- **External developers** without access to HPC systems can test and engineer **their codes on HPC resources**.
- **Extensibility**: Option to **compare** performance with **other software** libraries.

GPE

https://bssw.io/blog_posts/the-art-of-writing-scientific-software-in-an-academic-environment

Anzt et al: **"Towards Continuous Benchmarking: An Automated Performance Evaluation Framework for High Performance Software"**, PASC 2019.

Summary

Work in progress...
Anyone Interested in a thesis project?

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Learn More about Ginkgo

- Open-source C++ framework for sparse linear algebra.
- Sparse linear solvers, preconditioners, SpMV etc.
- Generic algorithm implementation:
  + reference kernels for checking correctness;
  + architecture-specific highly optimized kernels.
- Focused on GPU accelerators (i.e. NVIDIA GPUs).
- Software quality and sustainability efforts guided by xSDK community policies:
  - open source, BSD
  - Doxygen
  - CMake Cross-platform Make
  - googletest Google C++ Testing Framework, GitLab CI

https://xsdk.info/

Ginkgo

https://ginkgo-project.github.io/


Terry Cojean


Goran Flegar


Thomas Grützmacher


Pratik Nayak


Tobias Ribizel

better scientific software

https://bssw.io/