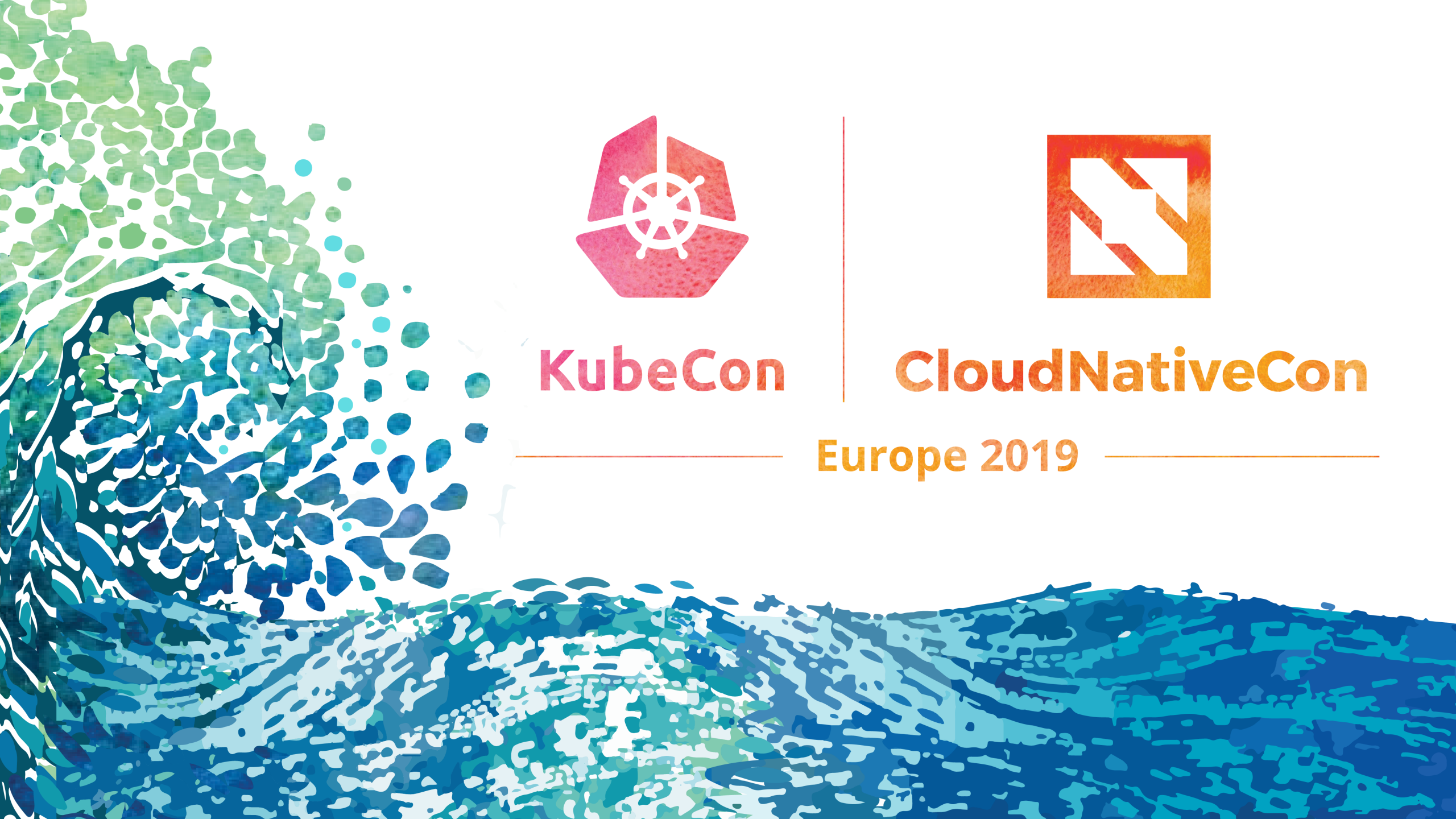
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What's the Performance Overhead?

Answering the Biggest Question in Tracing

Gabriela Soria

Former Outreachy intern for CNCF

About me – Outreachy

Outreachy provides three-month paid internships to work in Free and Open Source Software (FOSS) for under-represented people.

OPENTRACING

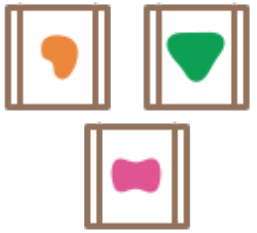
Agenda

- Introduction
- Benchmark tests
  - Scope and considerations
  - JMH Benchmark application example
  - Results
  - Conclusions
- Next steps

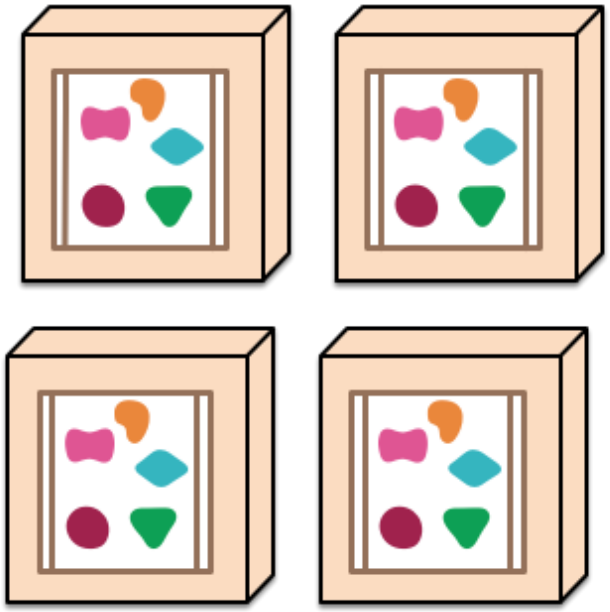
Introduction – Microservices

A monolithic application puts all its functionality into a single process...

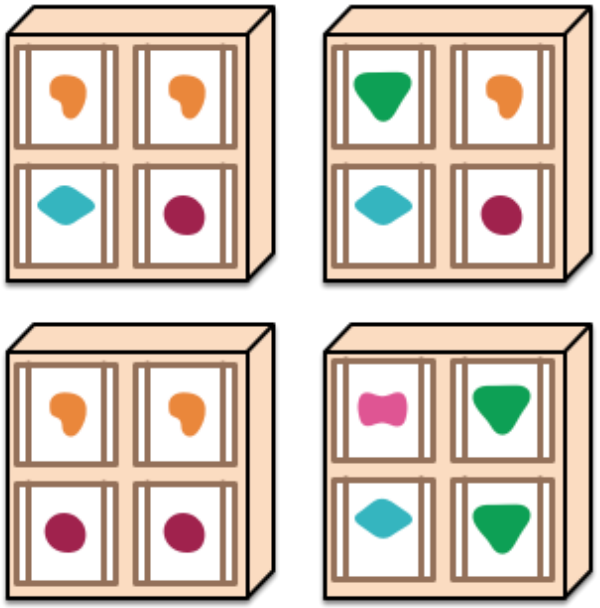
A microservices architecture puts each element of functionality into a separate service...



... and scales by replicating the monolith on multiple servers



... and scales by distributing these services across servers, replicating as needed.



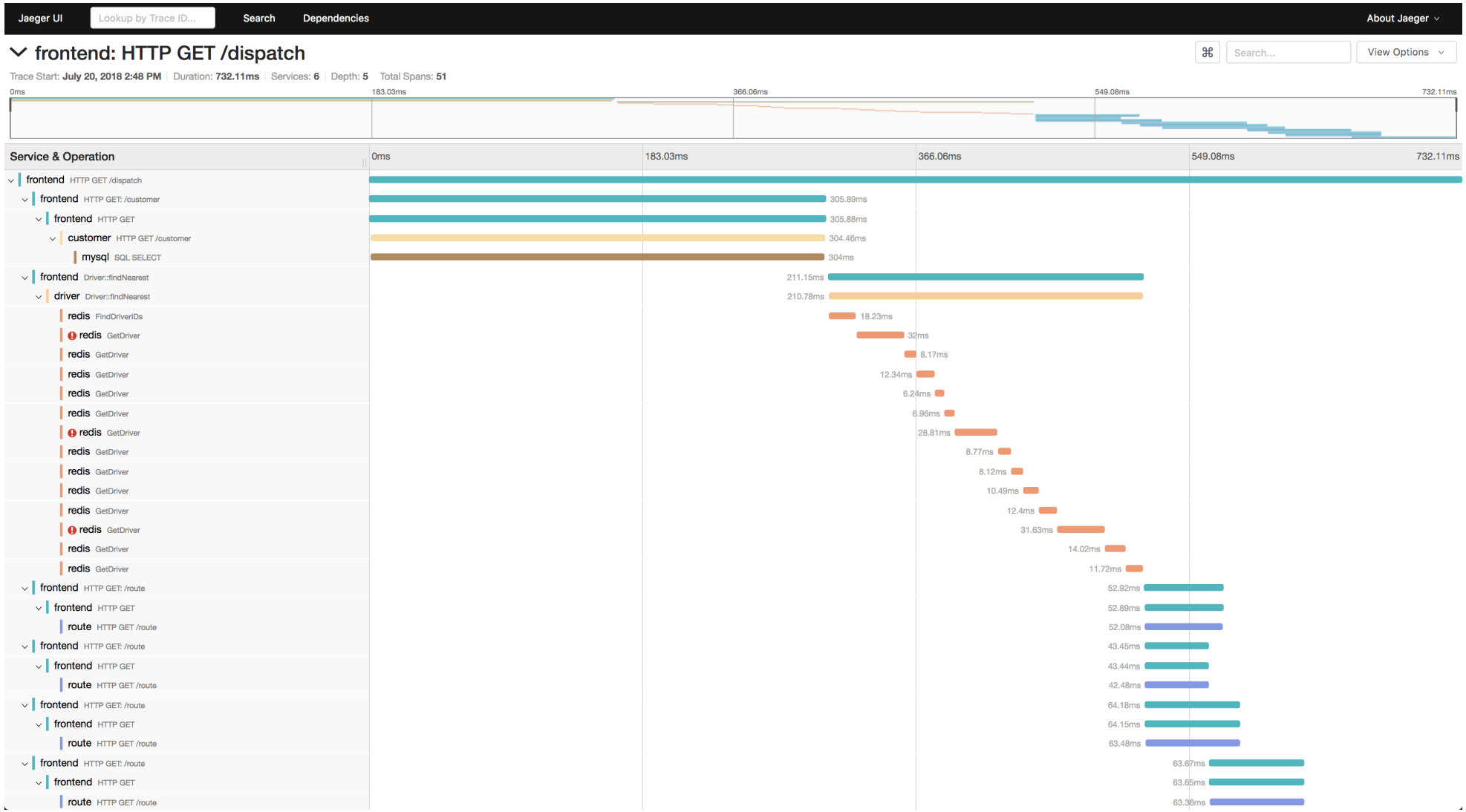
Source: https://martinfowler.com/articles/microservices.html

Distributed tracing – Opentracing

Distributed tracing profiles and monitor applications, especially those built using a microservices architecture.

OpenTracing is working towards creating more standardized APIs and instrumentation for distributed tracing.

Jaeger



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Source: https://www.jaegertracing.io/docs/1.11/

Scope and considerations

- We used Java Microbenchmark Harness (JMH)
- We used JMH Visualizer to present the results
- Tested Opentracing **Java** API only
- We tried to avoid network calls (in the scenarios that was possible)

JMH Benchmark Application Example

- Create a JMH application:

```
mvn archetype:generate \
-DinteractiveMode=false \
-DarchetypeGroupId=org.openjdk.jmh \
-DarchetypeArtifactId=jmh-java-benchmark-archetype \
-DgroupId=org.sample \
-DartifactId=jmh-examples \
-Dversion=1.0
```

JMH Benchmark Application Example


```
public class BenchmarkPetclinicSampleTime extends BenchmarkPetclinicBase {

    @Benchmark
    @BenchmarkMode(Mode.SampleTime)
    public Owner noInstrumentation(StateVariablesNoInstrumentation state) {
        return findPetOwnerById(state);
    }

    @Benchmark
    @BenchmarkMode(Mode.SampleTime)
    public Owner noopTracer(StateVariablesNoopTracer state) {
        return findPetOwnerById(state);
    }

    @Benchmark
    @BenchmarkMode(Mode.SampleTime)
    public Owner jaegerTracer(StateVariablesJaeger state) {
        return findPetOwnerById(state);
    }
....
```

JMH Benchmark Application Example


```
public class BenchmarkPetclinicBase {

  public Owner findPetOwnerById(StateVariables state) {
    return state.petcontroller.findOwner(1);
  }
  @State(Scope.Benchmark)
  public static class StateVariables {
    public PetController petcontroller;
    public ConfigurableApplicationContext c;

    @TearDown(Level.Iteration)
    public void shutdownContext() {
      c.close();
    }

    public void initApplication() {
      c = SpringApplication.run(PetClinicApplication.class);
      petcontroller = c.getBean(PetController.class);
    }
  }
```

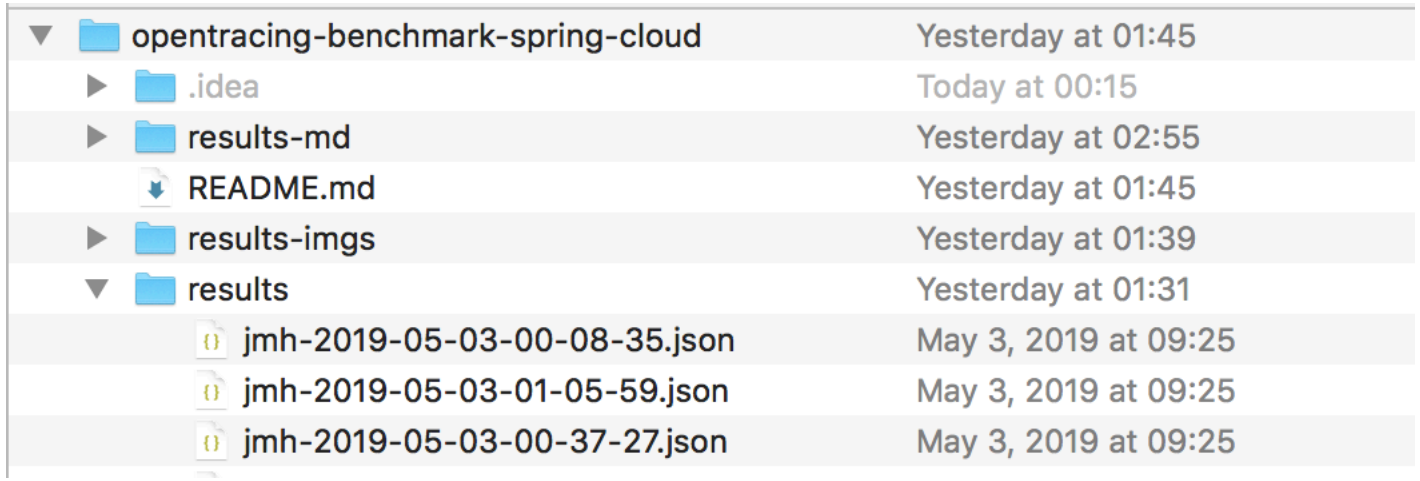
JMH Benchmark Application Example


```
public static class StateVariablesNoInstrumentation extends StateVariables {
    @Setup(Level.Iteration)
    public void doSetup() {
        System.setProperty("tracerresolver.disabled", Boolean.TRUE.toString());
        initApplication();
    }
}

public static class StateVariablesJaeger extends StateVariables {
    @Setup(Level.Iteration)
    public void doSetup() {

        System.setProperty(AbstractEnvironment.ACTIVE_PROFILES_PROPERTY_NAME,
TracerImplementation.JAEGERTRACER);
        initApplication();
    }
}
```

JMH Benchmark Application Example

- Run the tests:

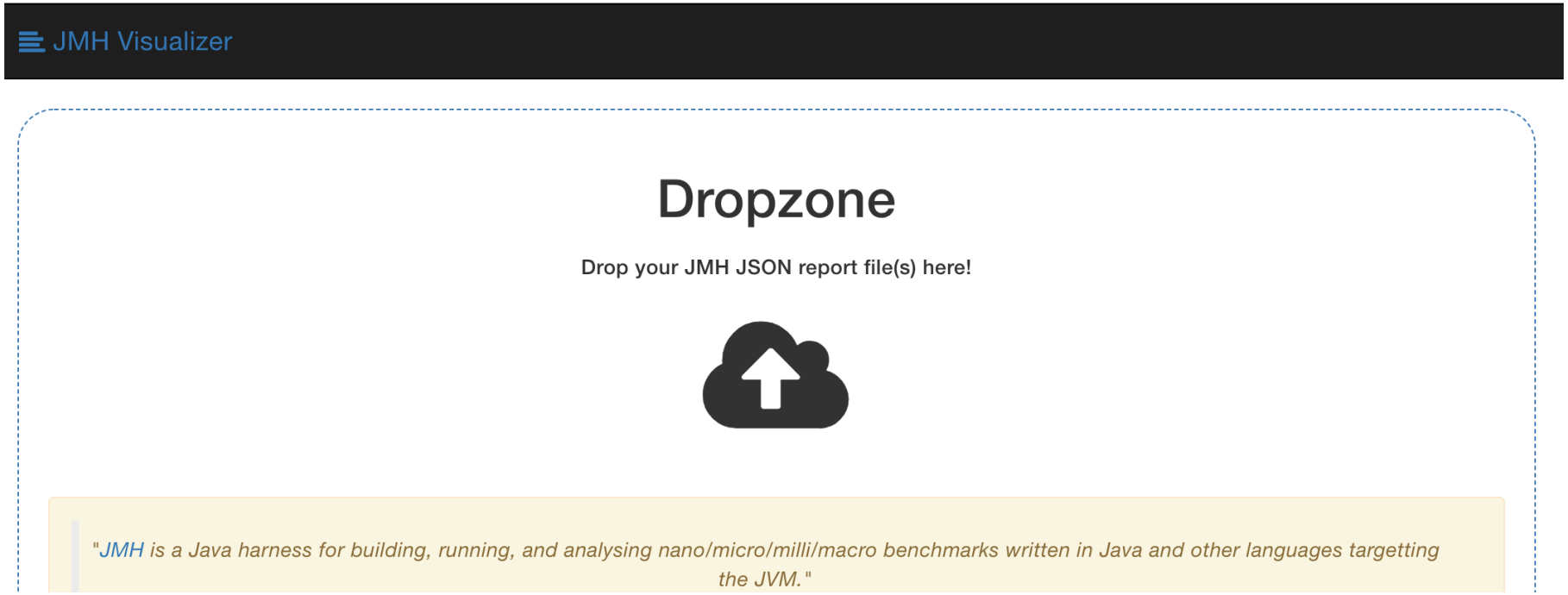
```
mvn clean install
java -jar target/benchmarks.jar
```



JMH Benchmark Application Example

- Visualize the results

  http://jmh.morethan.io/



List of tests

Scenario	Dependency	Description	HTTP calls	Framework
Simple Java	opentracing-java (manually)	String concatenation	No	No
Spring Boot	opentracing-java (manually)	Billing process	No	Yes
Spring Cloud	opentracing-spring-cloud-starter	Petclinic	No	Yes
JDBC (in memory database)	opentracing-jdbc	Spring Boot - Course Management	No	Yes
Servlet Filter	opentracing-web-servlet-filter	Simple servlet – Hello World Page	**Yes**	Yes
JAX-RS	opentracing-jaxrs2-discovery	Spring Boot - Course Management	**Yes**	Yes

Results – Simple Java (Sample time)

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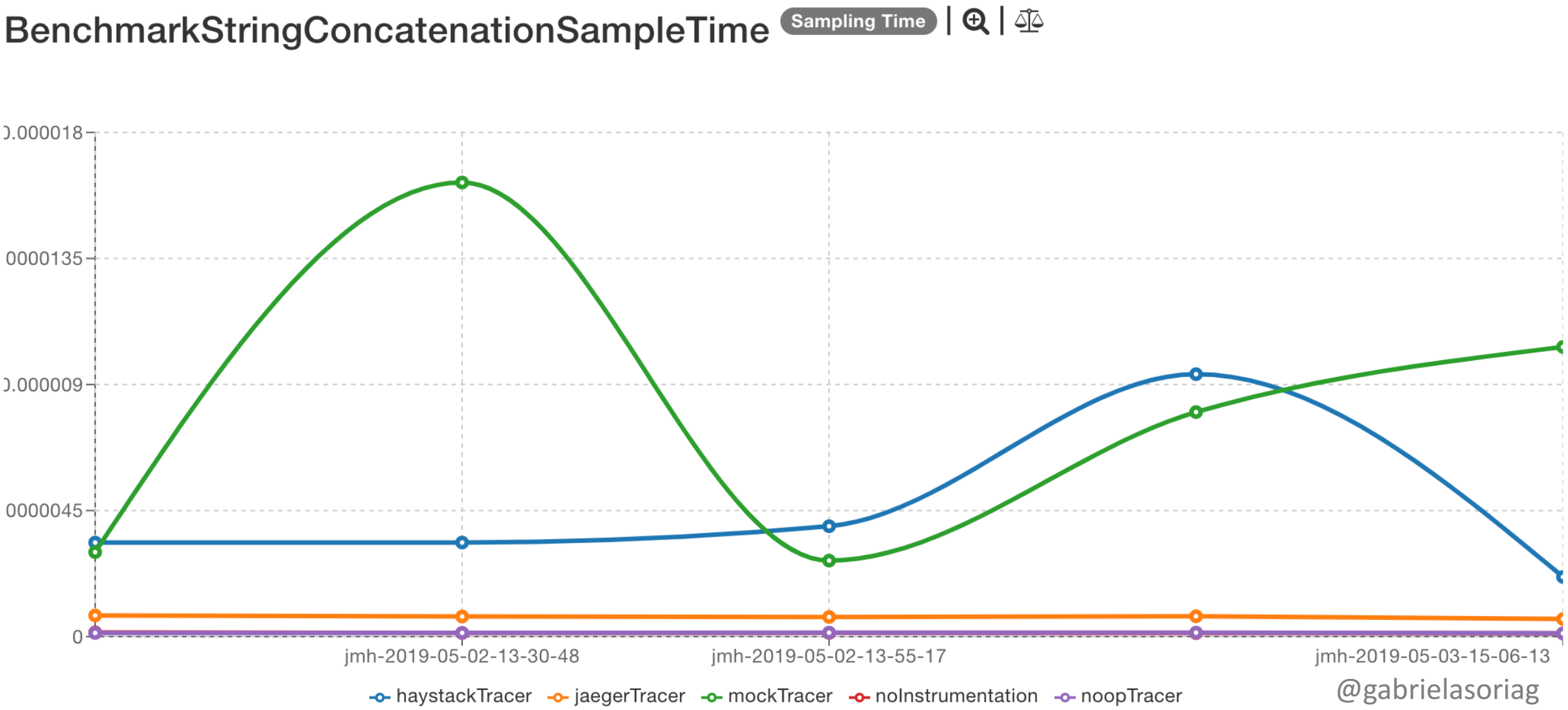

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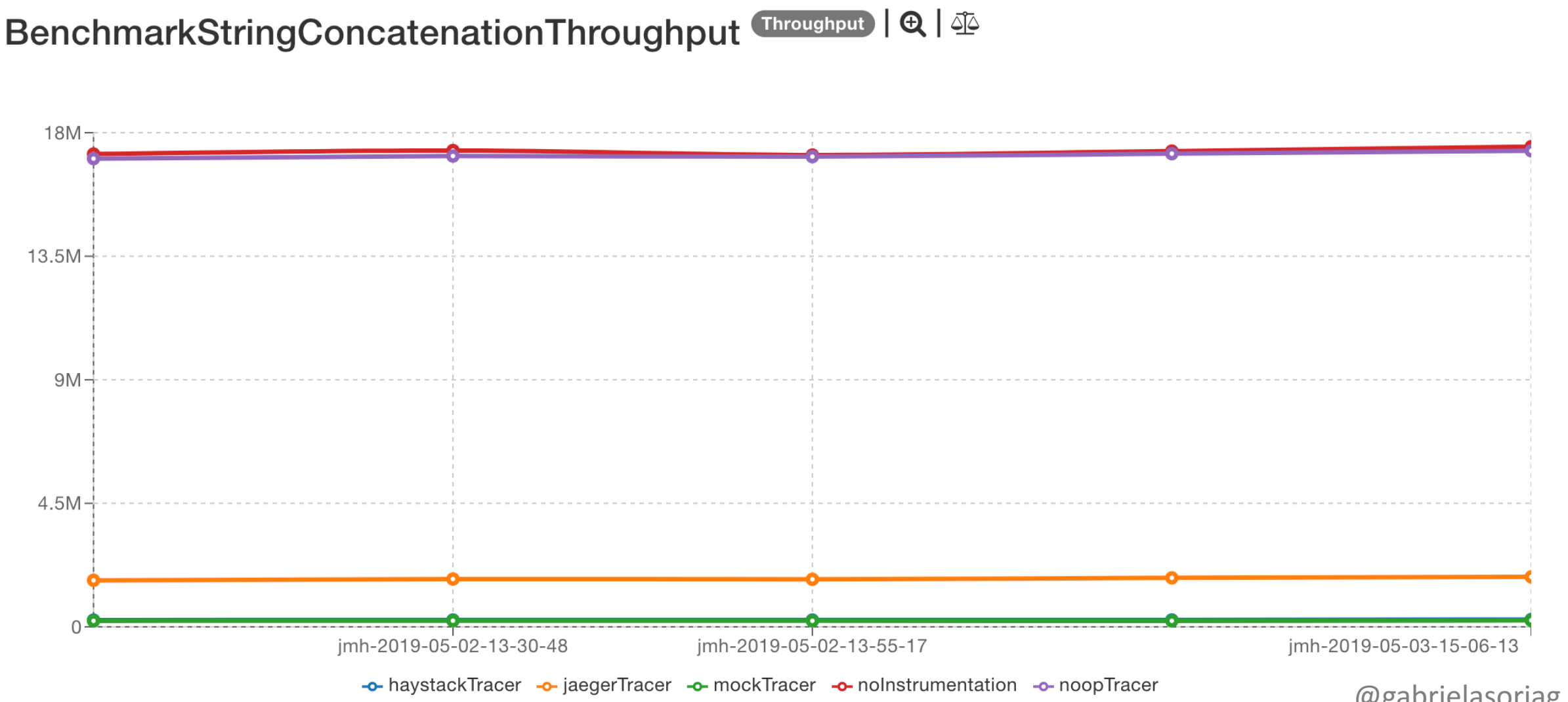
Results – Simple Java (Throughput)



Results – Spring boot (Sample time)

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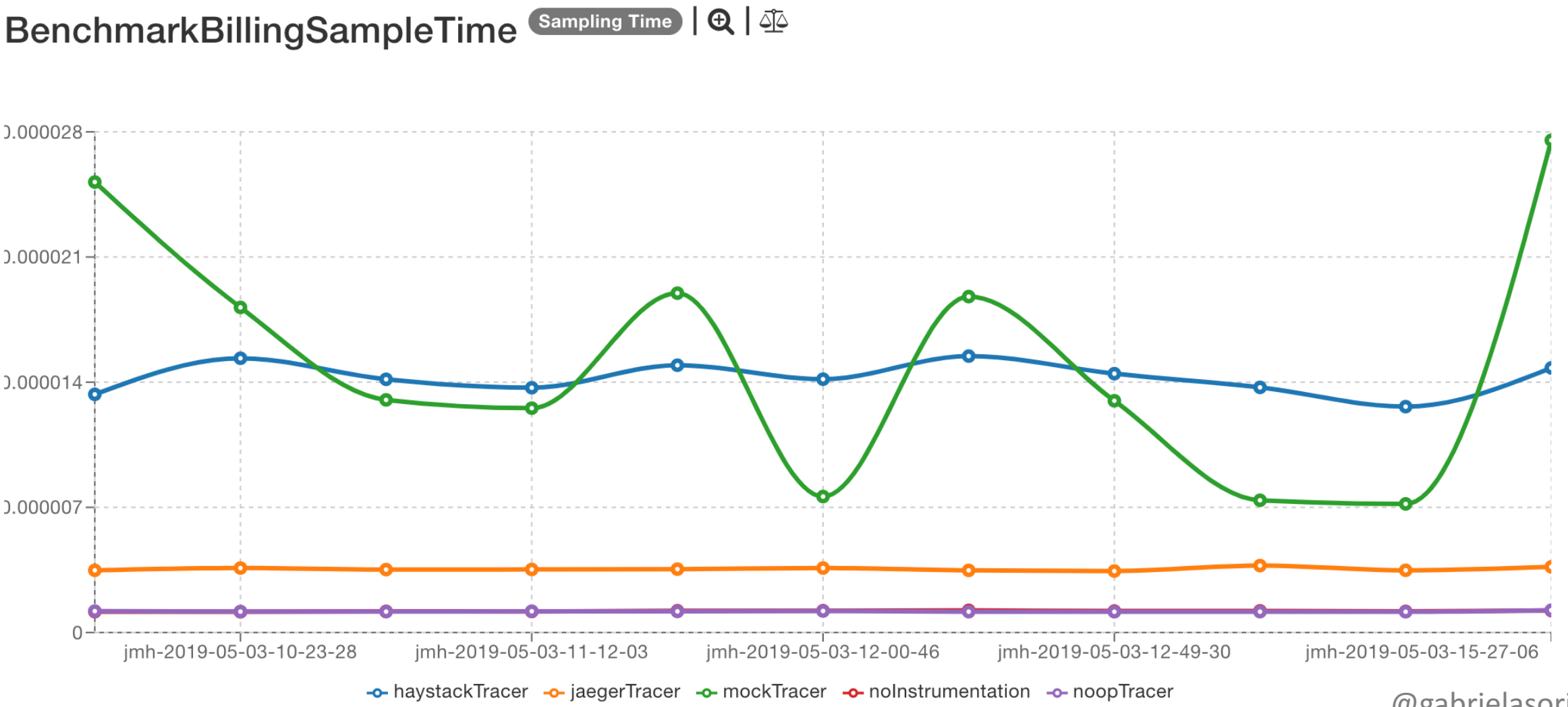

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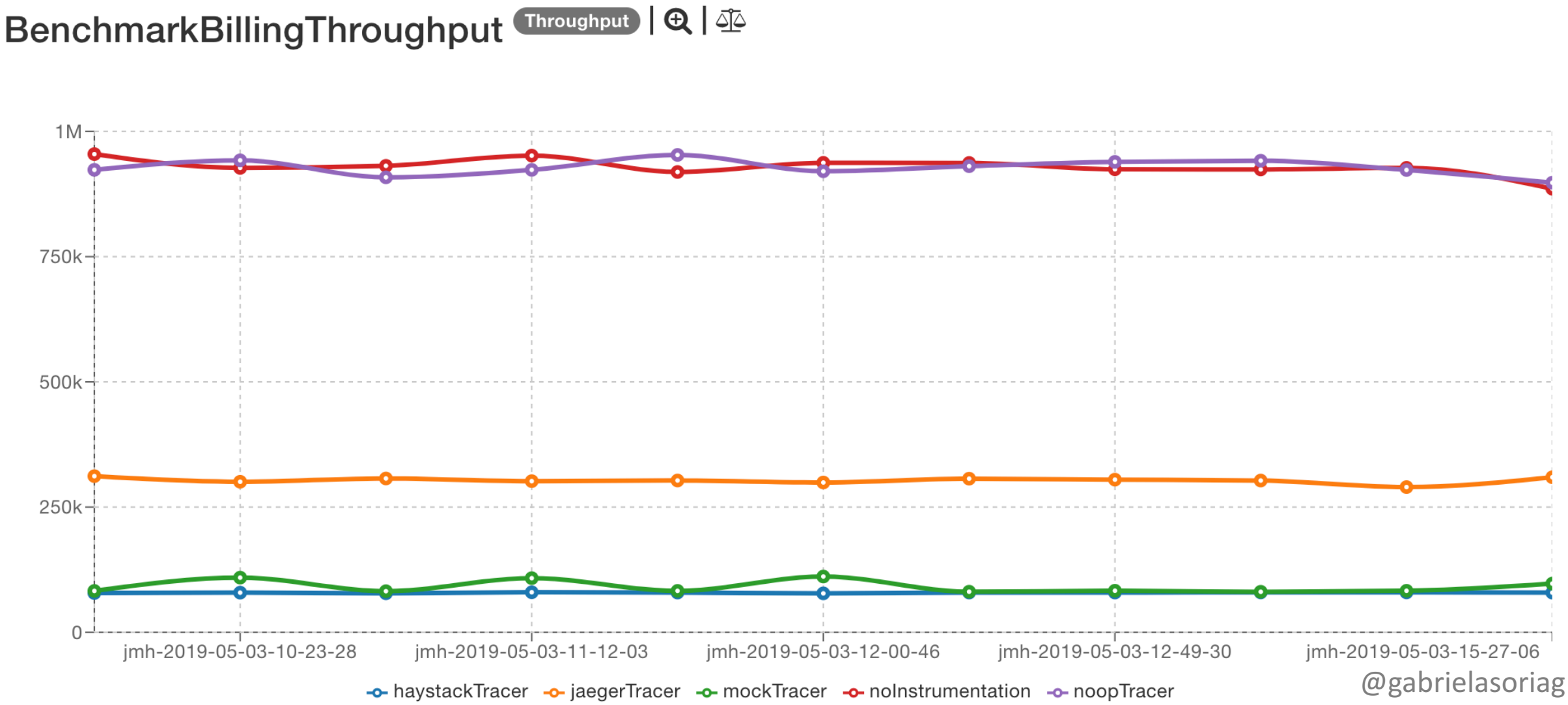
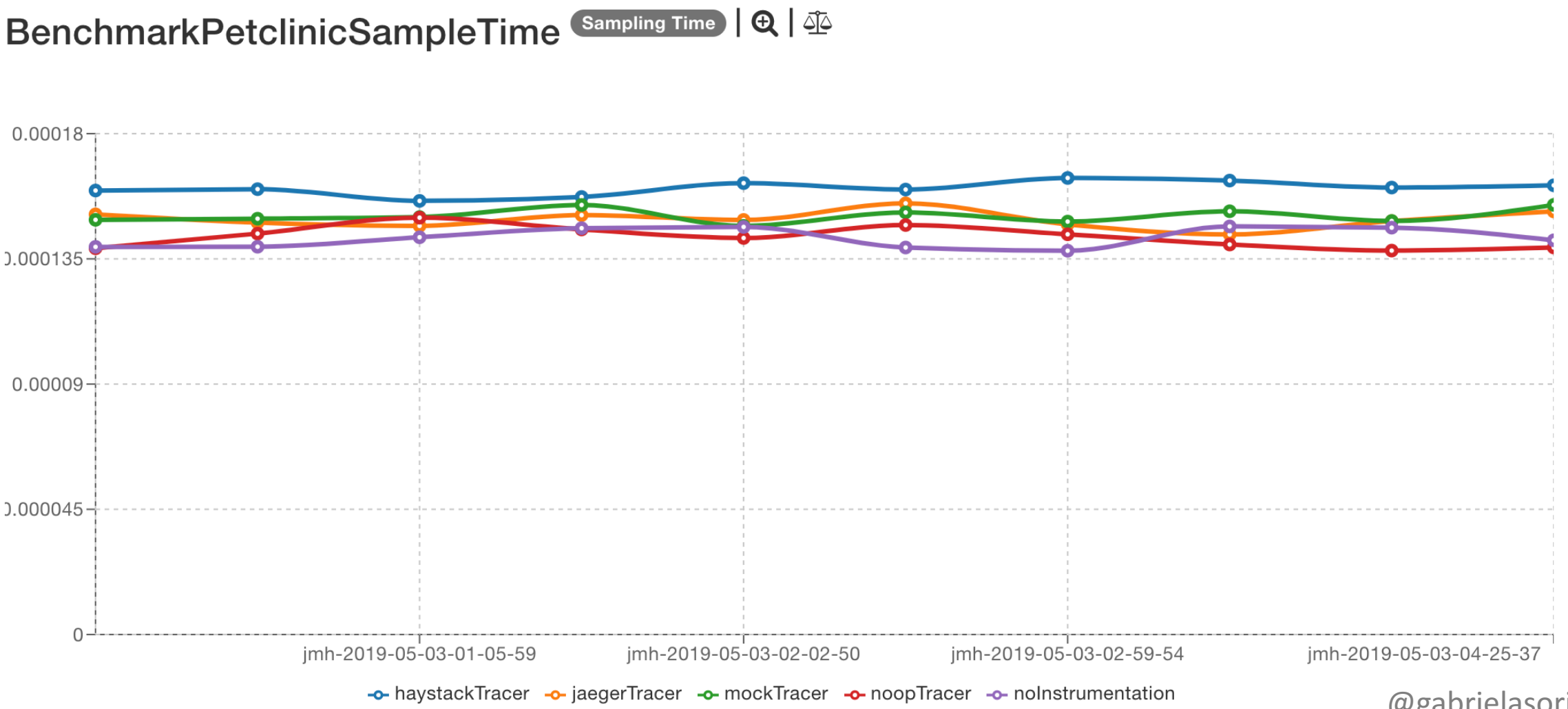
Results – Spring boot (Throughput)



Results – Spring Cloud (Sample time)



Results – Spring Cloud (Throughput)

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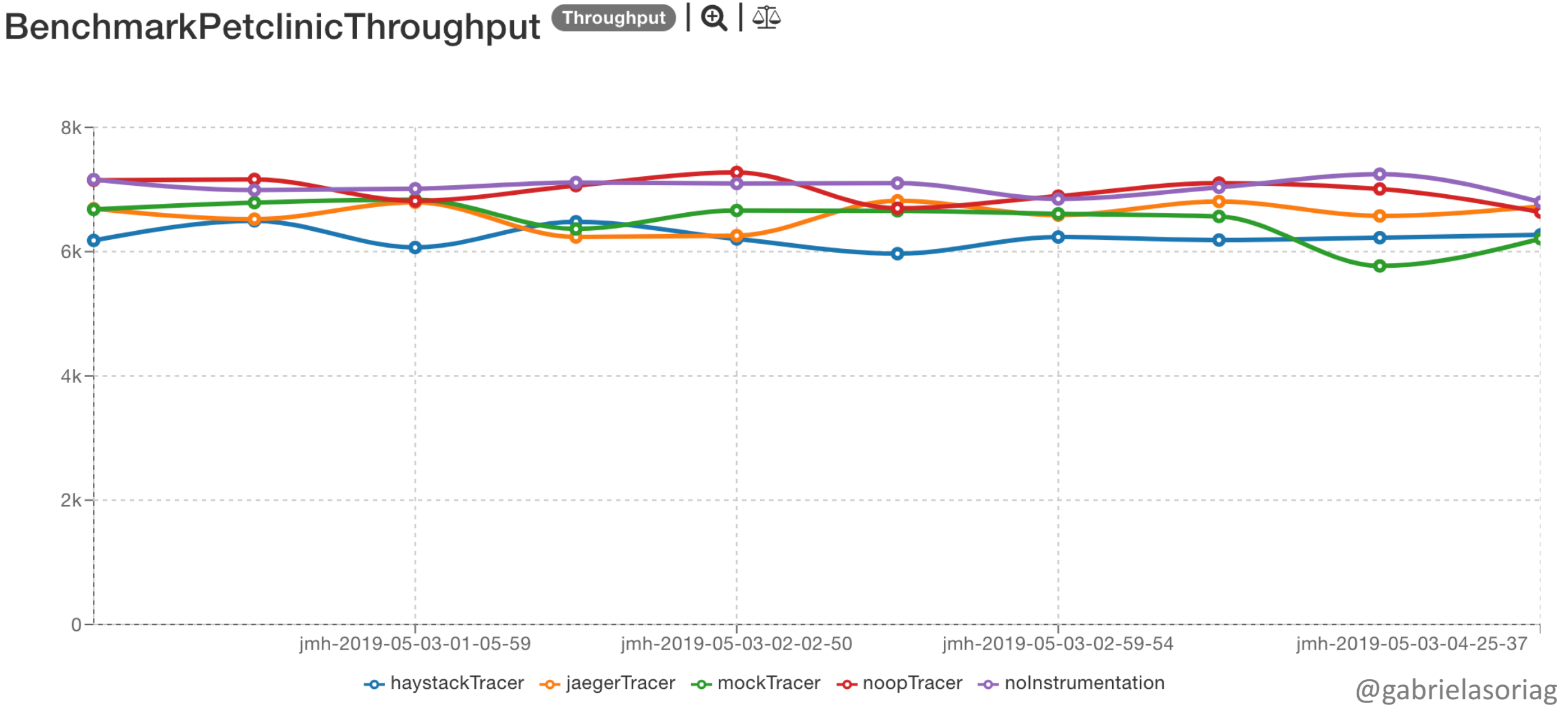

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Results – JDBC (Sample time)

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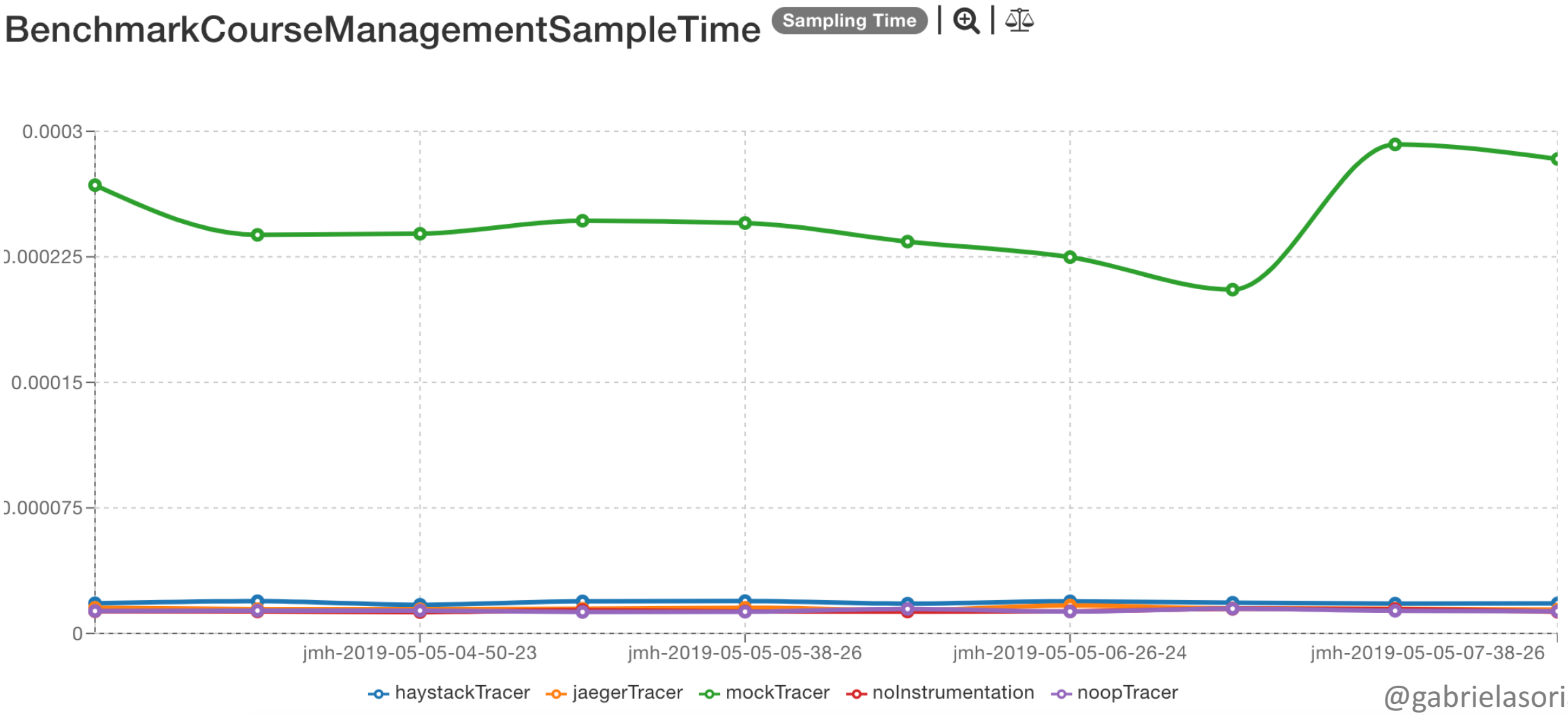

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Results – JDBC (Throughput)

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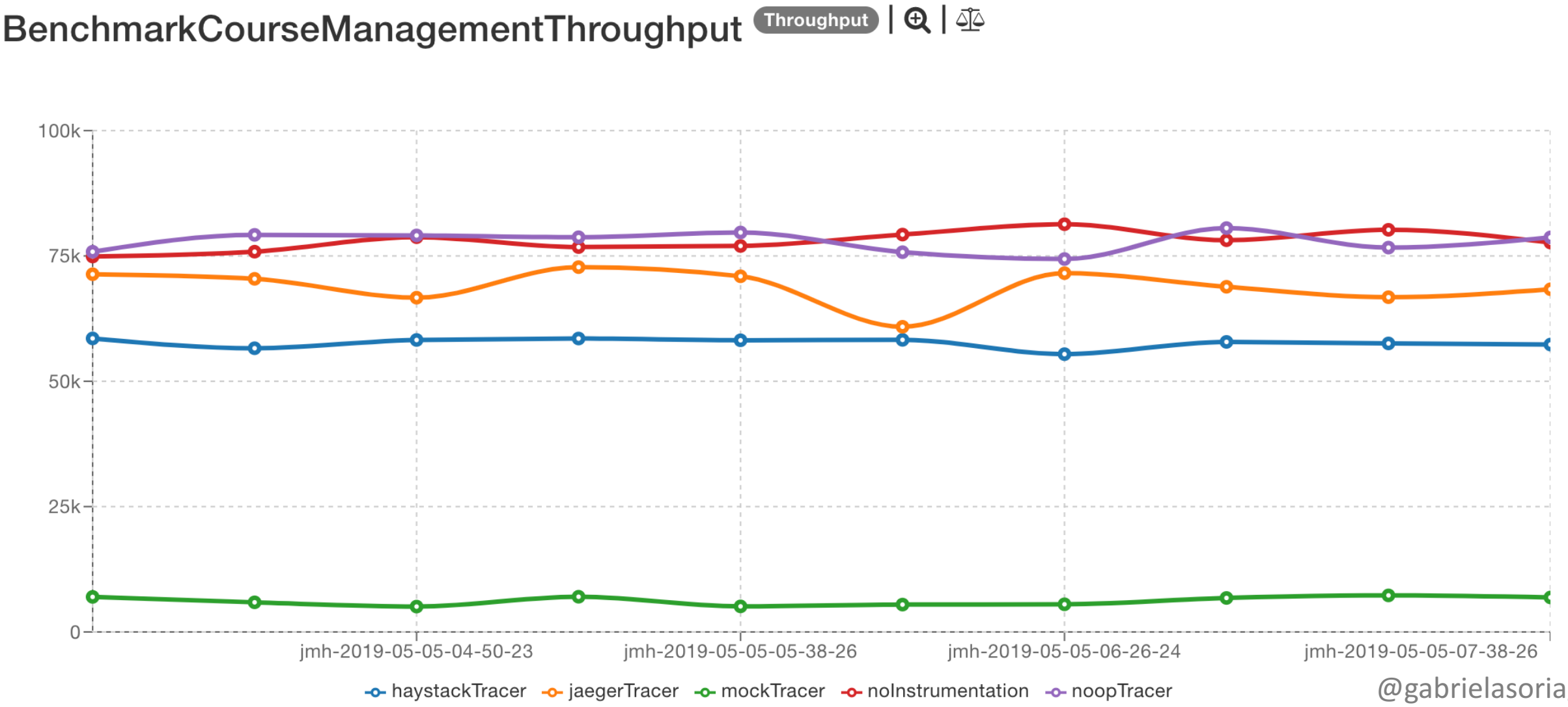
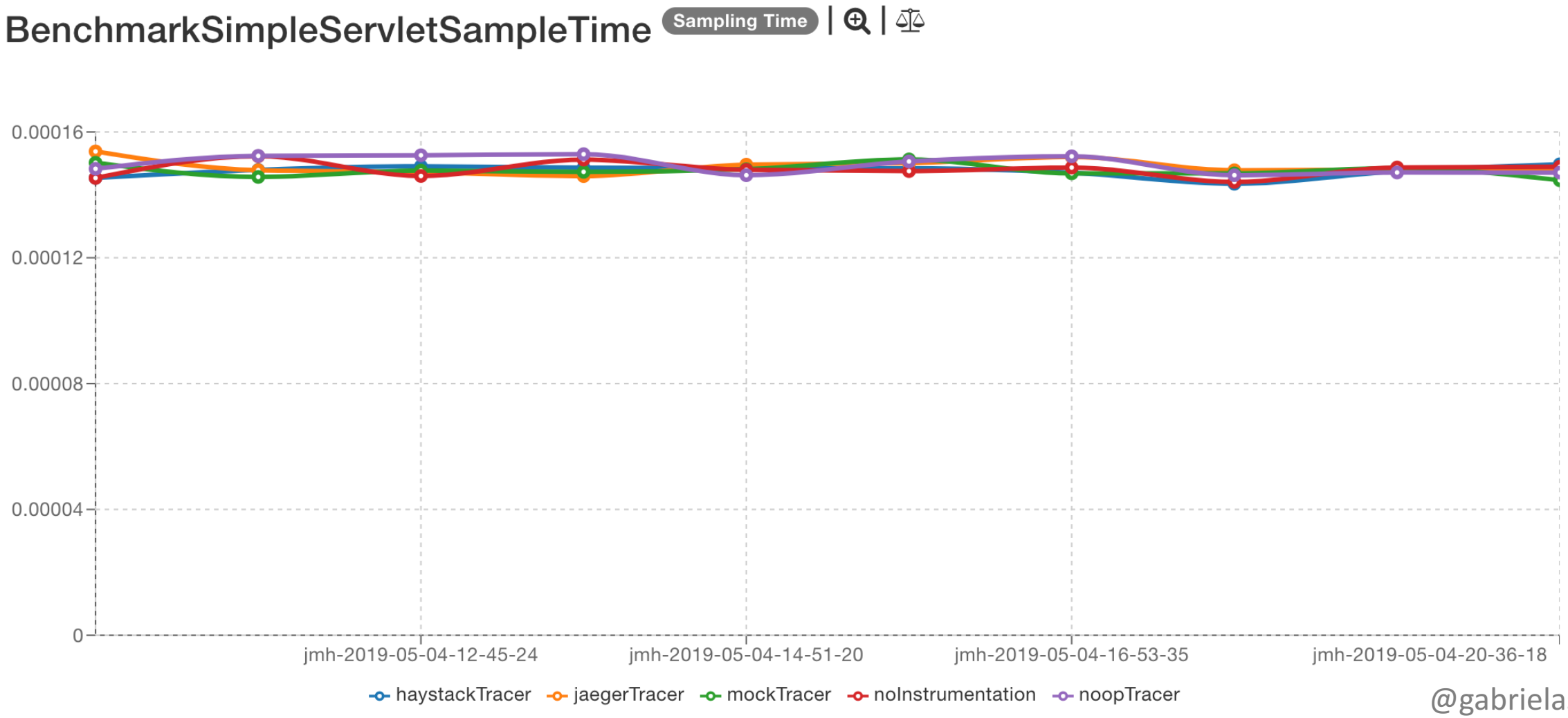
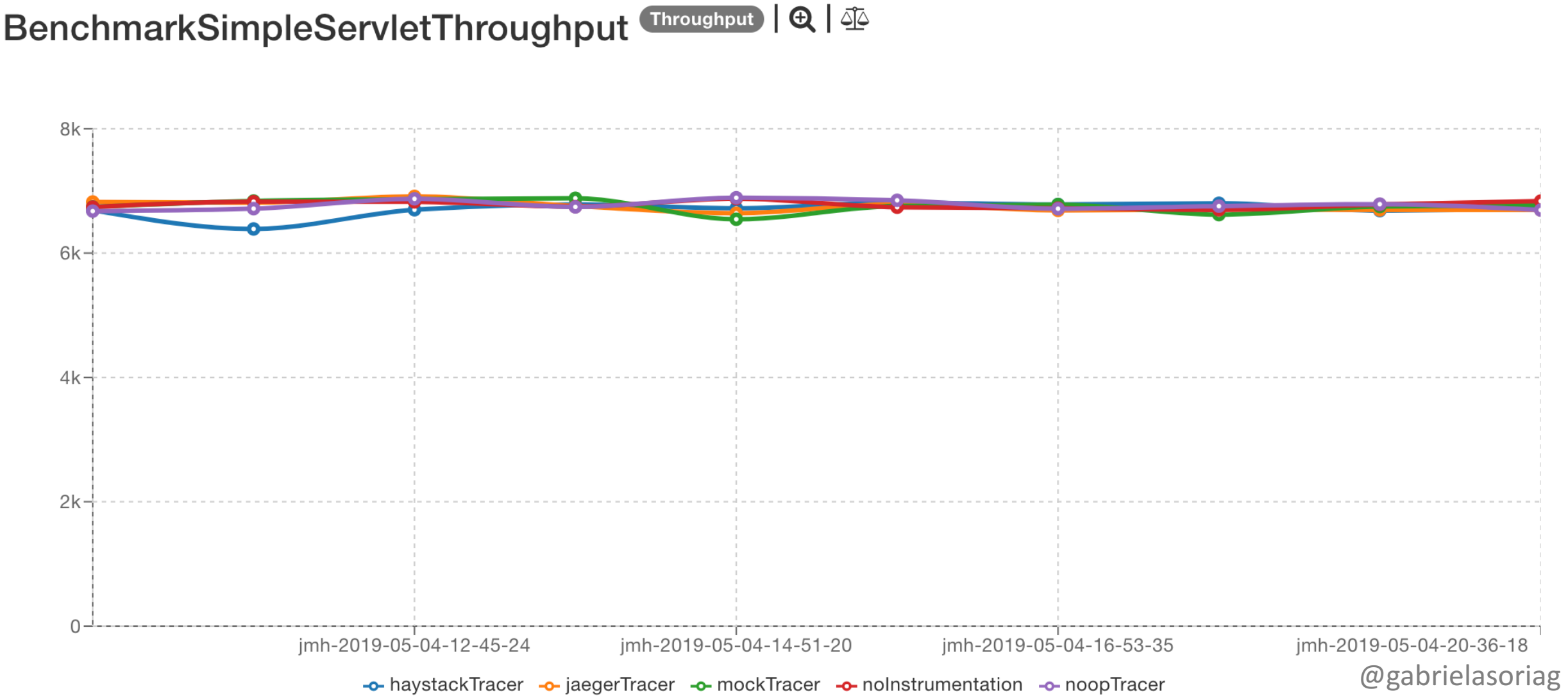


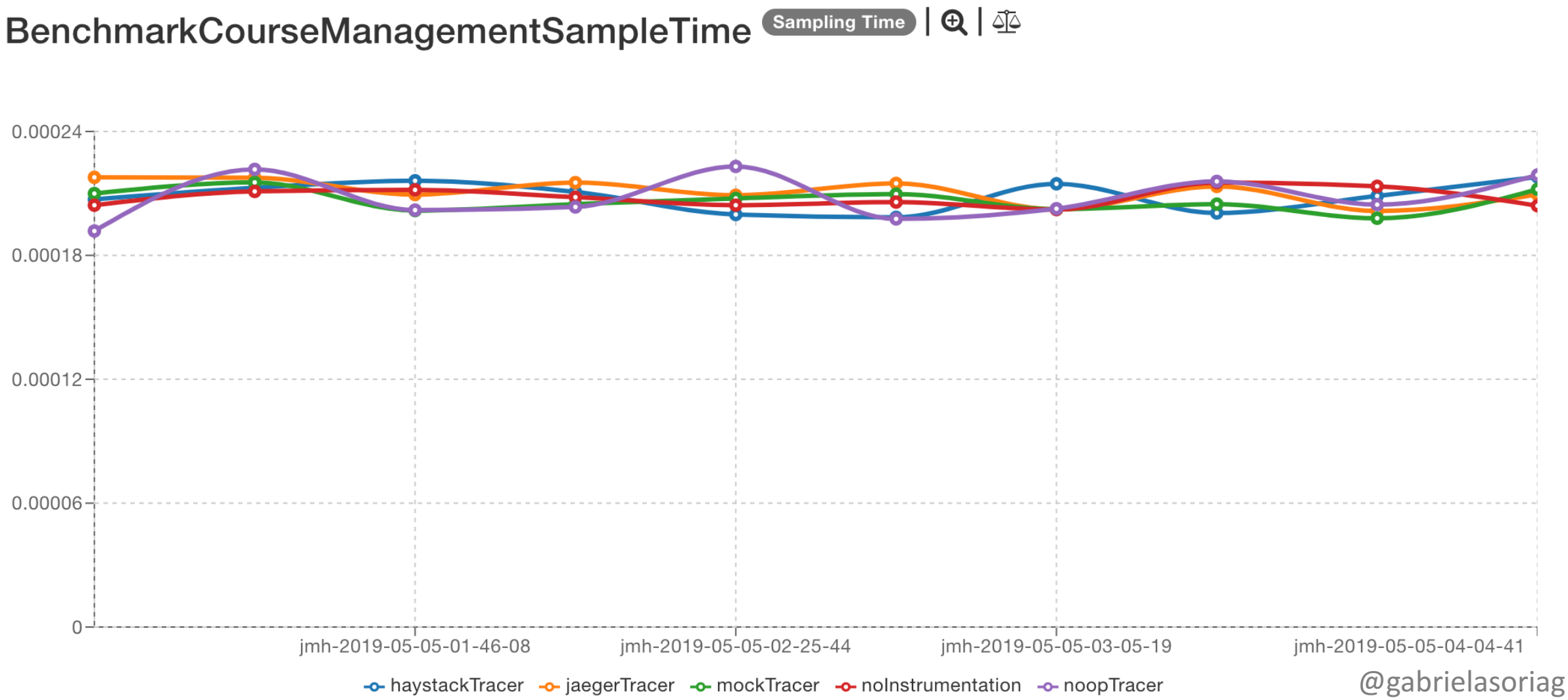
Results – Servlet Filter (Sample time)



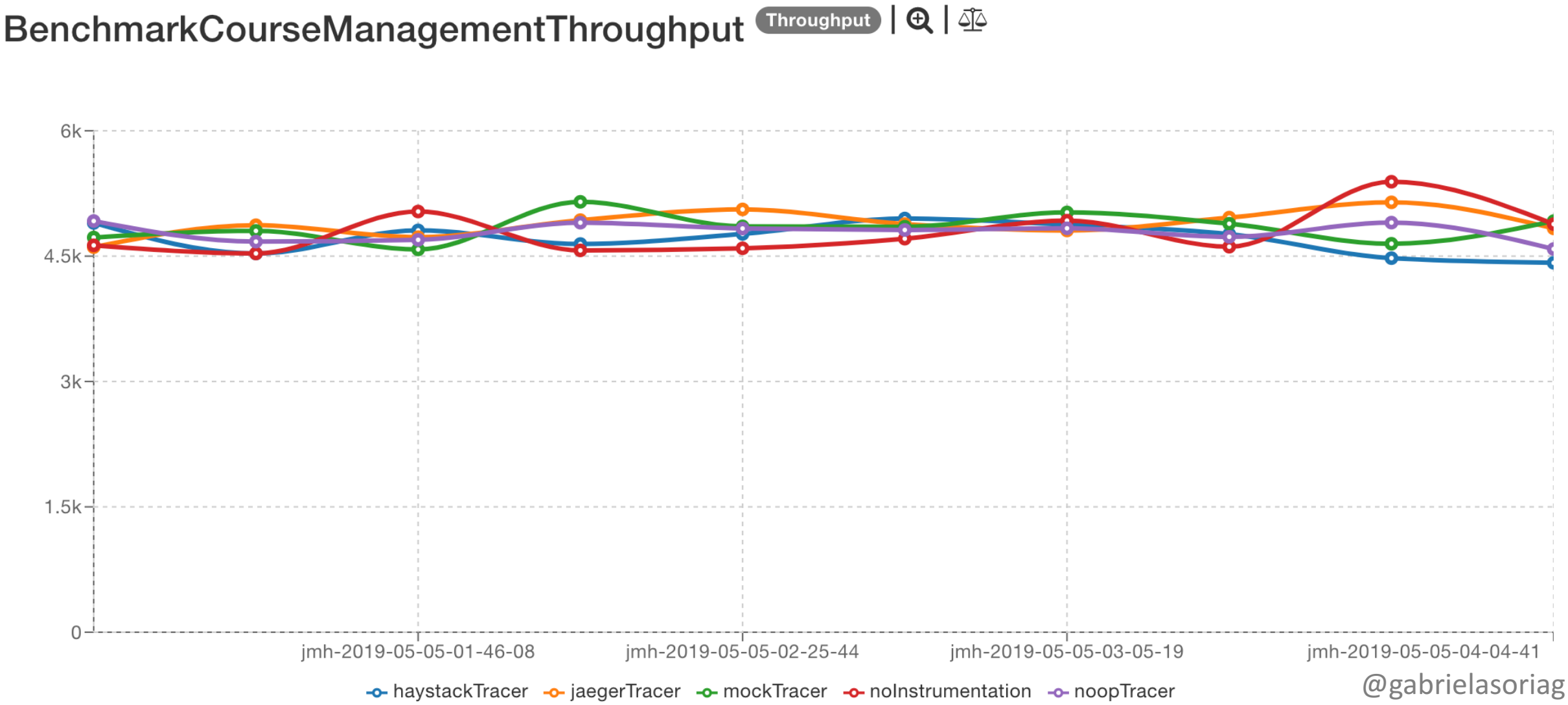
Results – Servlet Filter (Throughput)



Results – JAX-RS (Sample time)



Results – JAX-RS (Throughput)



Conclusions

- The overhead comes from the actual tracer and is closely related to how they work and how they are configured.
- In simple java scenarios the throughput **decreases ~90%** and the sample time **increases ~440%**
- In scenarios that include calls through the framework (spring boot, spring cloud, JDBC), on average, the throughput **decreases 12%** and the sample time **increases 14%**.

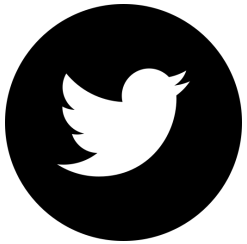
Conclusions

- In the scenarios with **client calls through HTTP** (Servlet Filter, JAX-RS), the metrics show **no evidence of overhead**, as the deltas of throughput and sample time are not representative.

Next steps

- Benchmark tests for Jaeger in different scenarios:
  - Sampling
  - gRPC vs. Thrift
  - Agent (UDP) vs. Collector (gRPC)
  - Different backend config
- Re-run the tests after merging OpenTracing and OpenCensus

Keep in touch :)



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Opentracing Java Benchmarks