DataStax

Developers

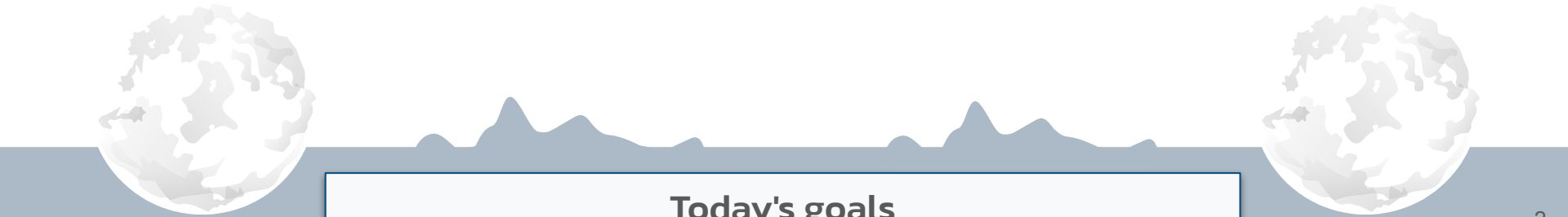
Benchmark your database with NoSQLBench

A serious performance testing tool for NoSQL data systems

Learn about testing a distributed NoSQL database (in the right way, at the right time)

Play with the powerful benchmarking tool **NoSQLBench** on a real DB

Try out the basics, peek at more advanced features, know where to go for more!



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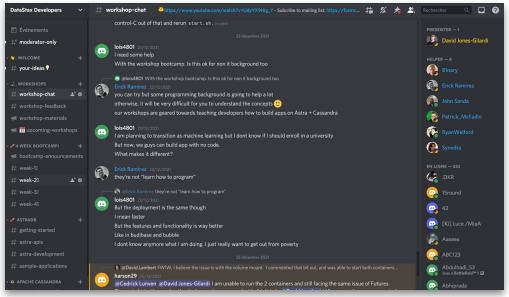
Live and Hands-on

Livestream: youtube.com/DataStaxDevs

YouTube

Twitch

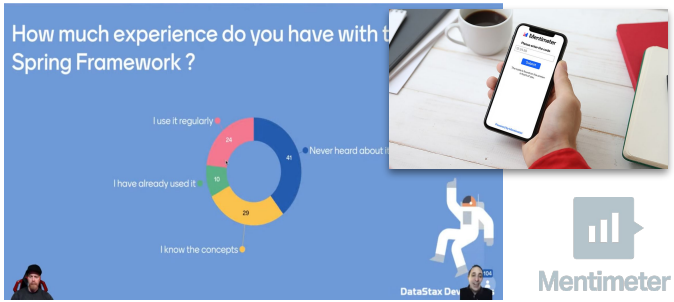
Questions: https://dtsx.io/discord



YouTube

Discord

Games and quizzes: menti.com

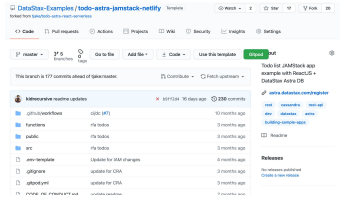


Mentimeter

Live Sessions

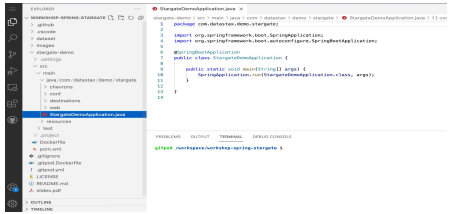
Nothing to install !

Commands + exercises + slides



GitHub

IDE



Gitpod

Distributed NoSQL Database

DataStax
Astra DB

Hands-On Housekeeping

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Benchmarking

Why, what, how?

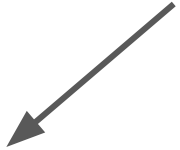
"Will the data system behind my app work as I want it to?"

"Will my data model work correctly?"

functional testing

"Will it support my millions of users?"
"Will it respond fast enough?"
"Will it transfer data at a sufficient rate?"

operational testing (performance)



Confidence/knowledge of your SLO (*service level objectives*)
Convincing decision makers about adopting a technology
Part of the assessments before a migration

Why "benchmarking" ?

Focus on operational testing (performance). Well-defined goals:

"Will it support my millions of users?" → testing scalability

"Will it respond fast enough?" → testing response time ("latency" *)

"Will it transfer data at a sufficient rate?" → testing throughput

We want to test **realistic workloads**, similar to what the actual application will do

Assumption: a NoSQL distributed database being used

Performance testing, strategies

"Distributed databases are hard to observe/measure"

- Must emulate realistic workload.
- High variance in responses under the best of conditions ("flakiness").

What can one do?

- Server-side instrumentation: powerful, but costly (and: not always access to DB internals)
- End-to-end ("black-box"): a.k.a. instrument the client
  - Will use public API ("no cheating").
  - Don't overdo (cost, maintenance).
  - Work with predictable environments (no snowflakes).

"A client sending reads/writes to the database and timing everything"

How ?

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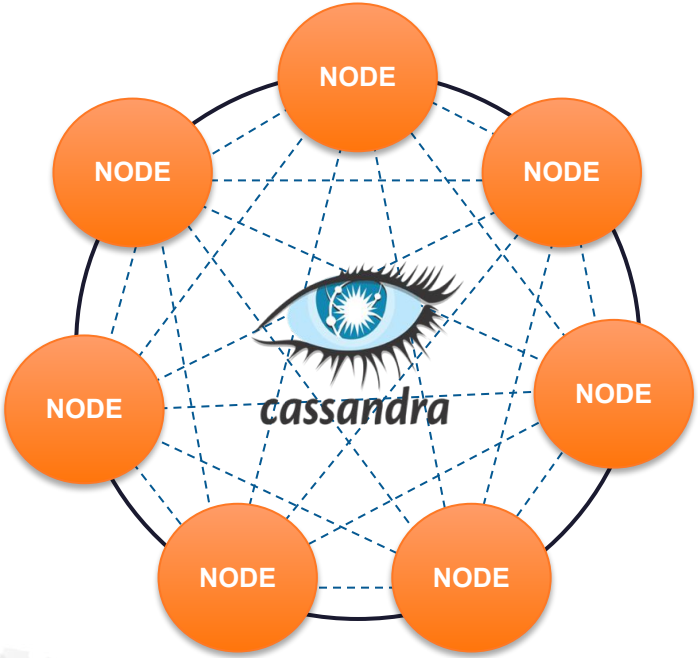
Cassandra & Astra DB

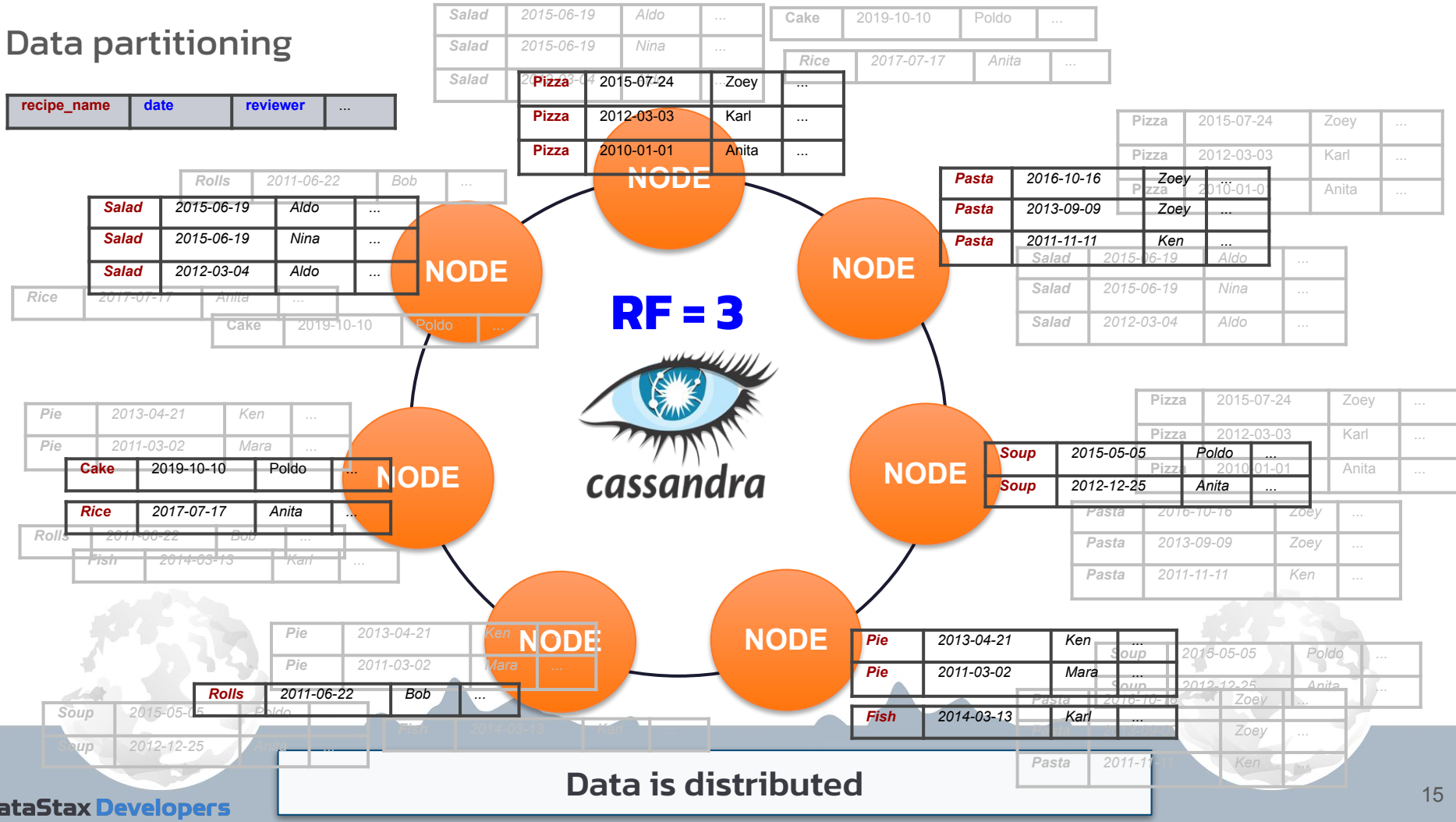
Apache Cassandra™: a powerful NoSQL database



- Big Data Ready
- Read / Write Performance
- Linear Scalability
- Highest Availability
- Self-Healing and Automation
- Geographical Distribution
- Platform Agnostic
- Vendor Independent

Data partitioning

recipe_name	date	reviewer	...



Pizza	2015-07-24	Zoey	...
Pizza	2012-03-03	Karl	...
Pizza	2010-01-01	Anita	...

Salad	2015-06-19	Aldo	...
Salad	2015-06-19	Nina	...
Salad	2012-03-04	Aldo	...

Pasta	2016-10-16	Zoey	...
Pasta	2013-09-09	Zoey	...
Pasta	2011-11-11	Ken	...

Soup	2015-05-05	Poldo	...
Soup	2012-12-25	Anita	...

Pie	2013-04-21	Ken	...
Pie	2011-03-02	Mara	...

Cake	2019-10-10	Poldo	...
Rice	2017-07-17	Anita	...

Rolls	2011-06-22	Bob	...
Fish	2014-03-13	Karl	...

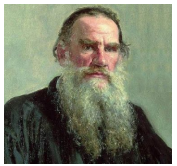
Data is distributed

Avoid "whole-table" queries!

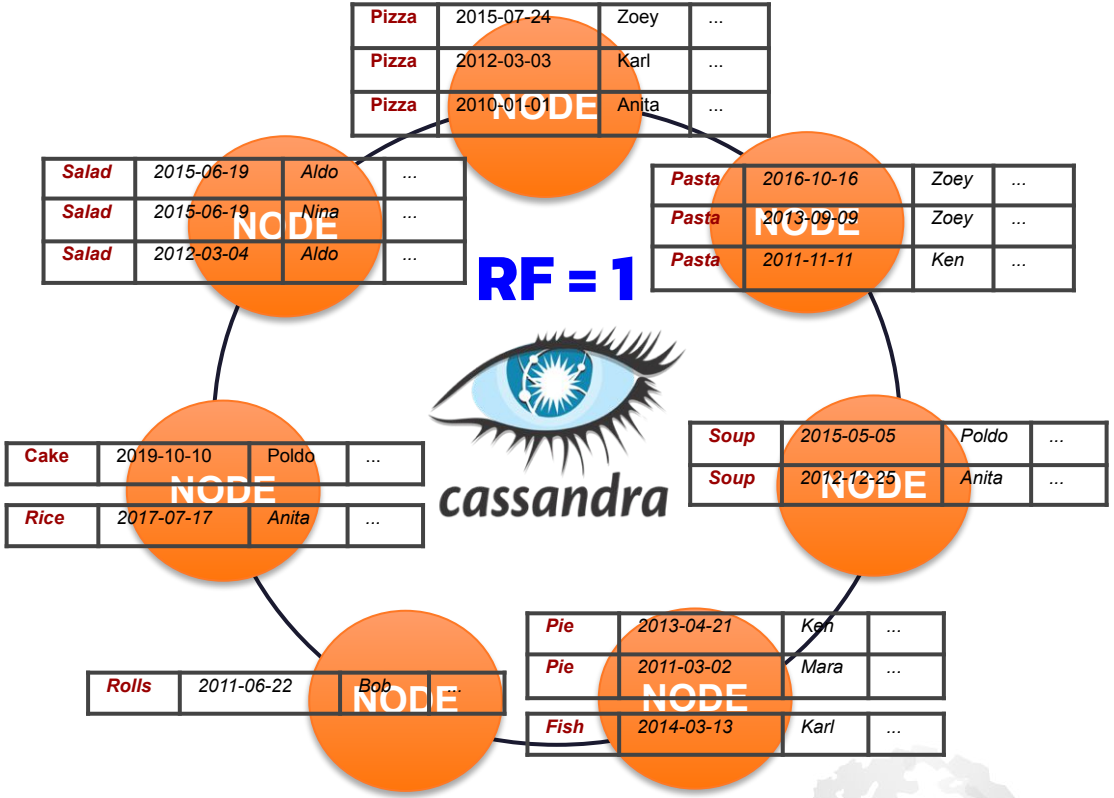
Carefully plan tables **after** thinking of the application

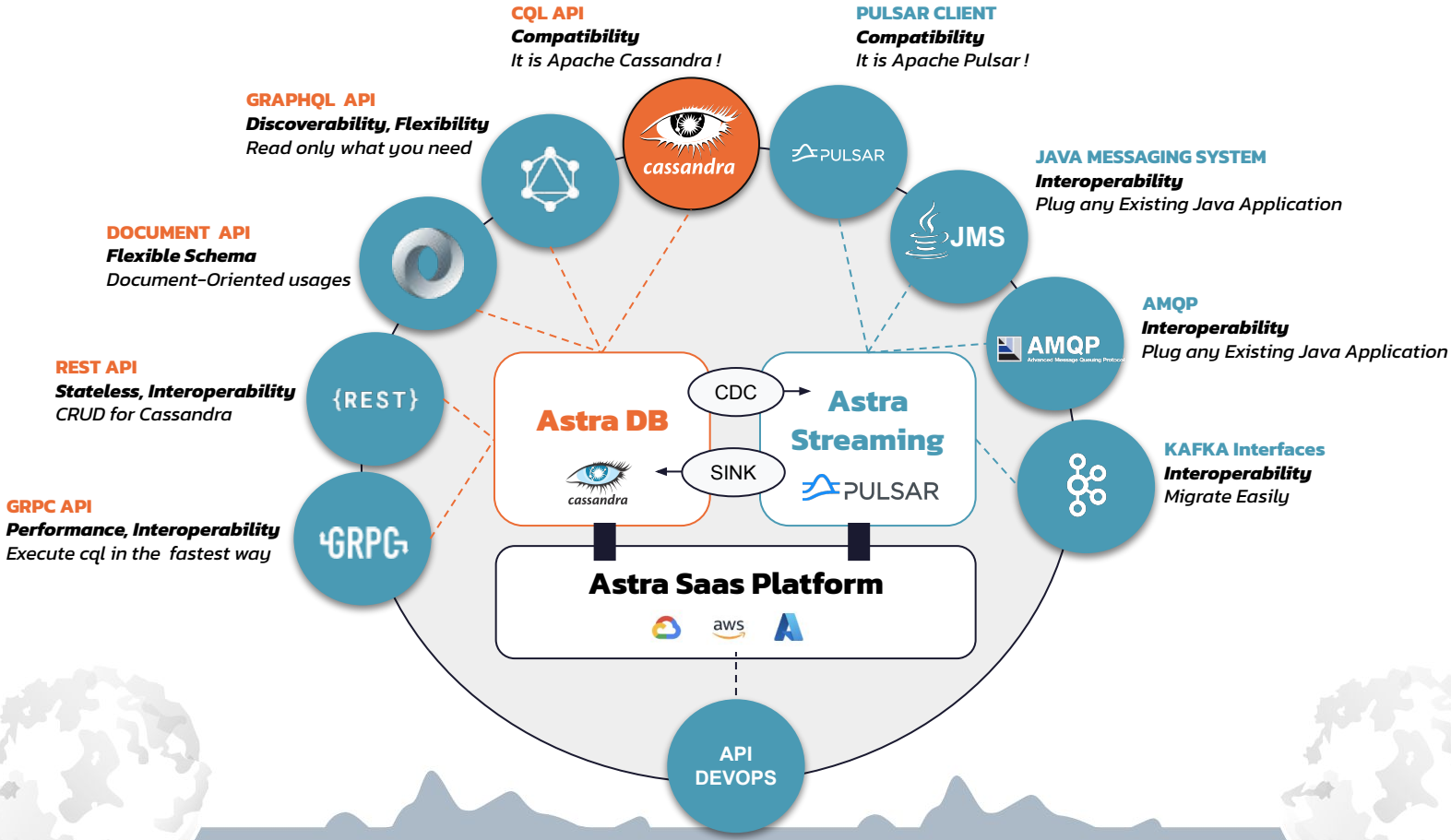
Denormalization is your friend

No JOINs!

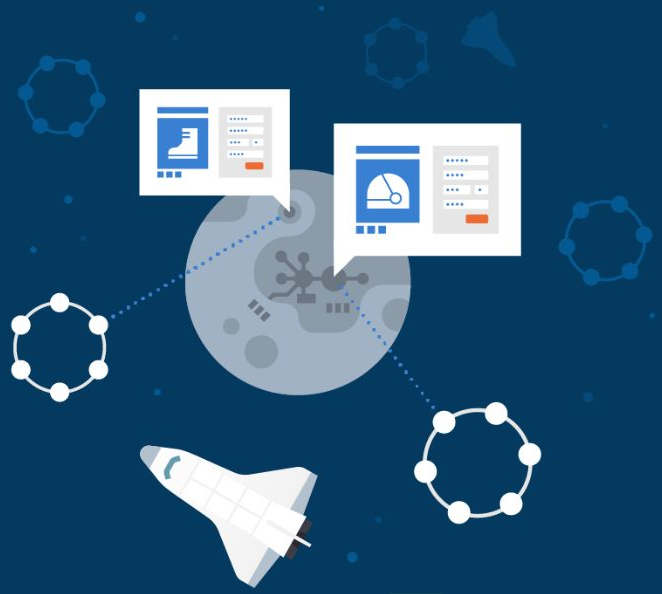


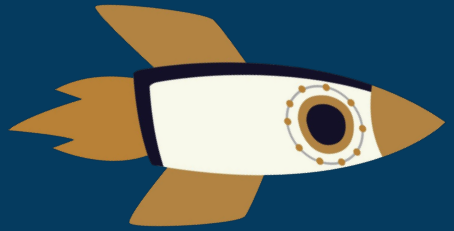
"All relational databases are alike; each NoSQL database is NoSQL in its own way"





Astra DB = managed Cassandra (*and much more*)



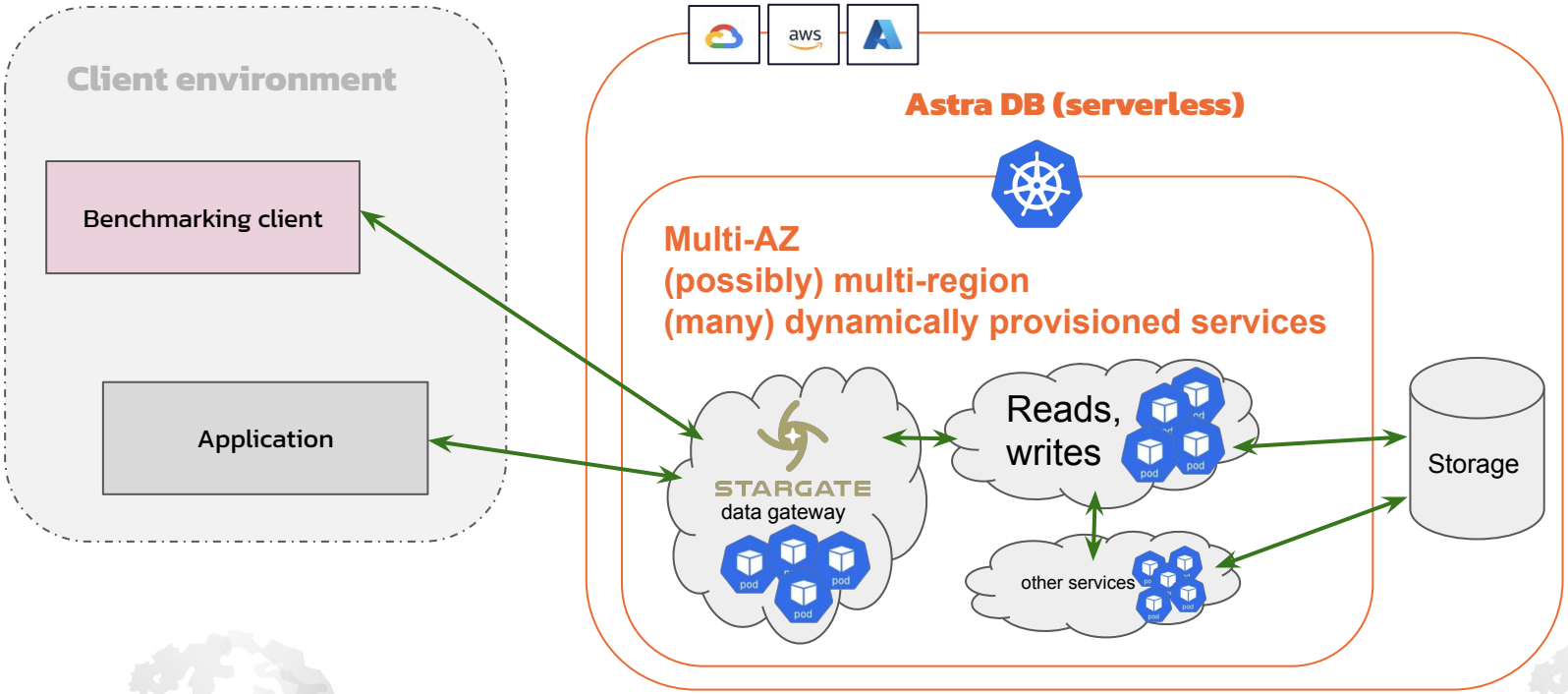


Hands-on (!github)

Database setup

- ✅ Create your database
- ✅ Create a token
- ✅ Download secure-connect-bundle

Data I/O with Astra DB



Astra DB: architecture sketch

Physical distances (& networking) matter

Benchmarking client

Where is the testing client located?

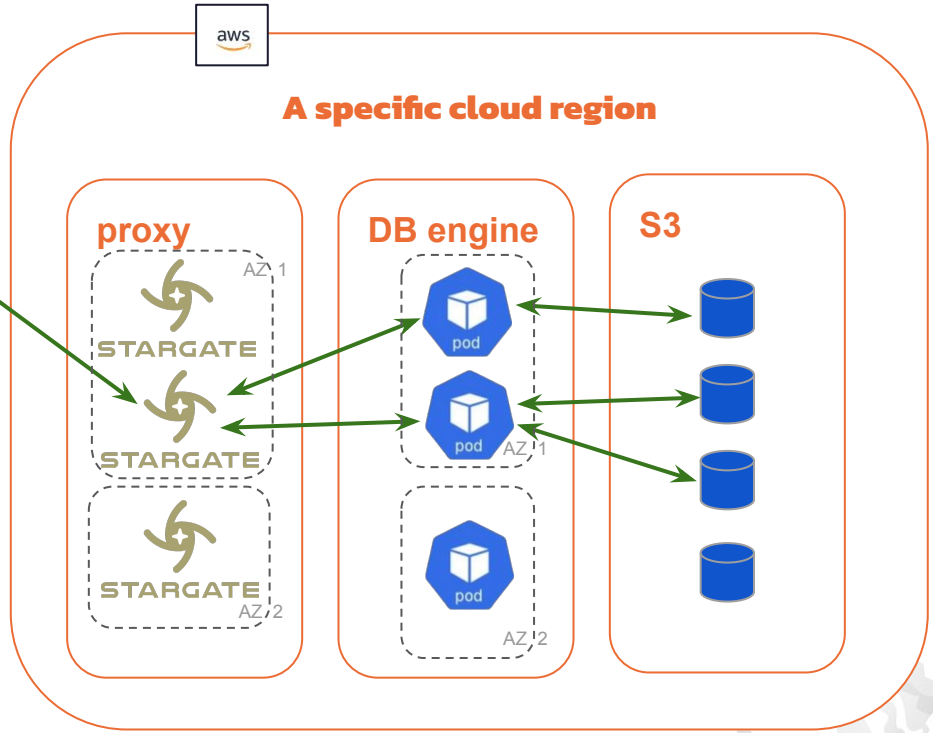
- Is it in AWS?
- Is it in the same region?

Where *should* it be?

- *"workload just like the actual app..."*

Cloud makes it all ambiguous:
what "latency" shall I measure?

Benchmarking on cloud: still relevant



An example request

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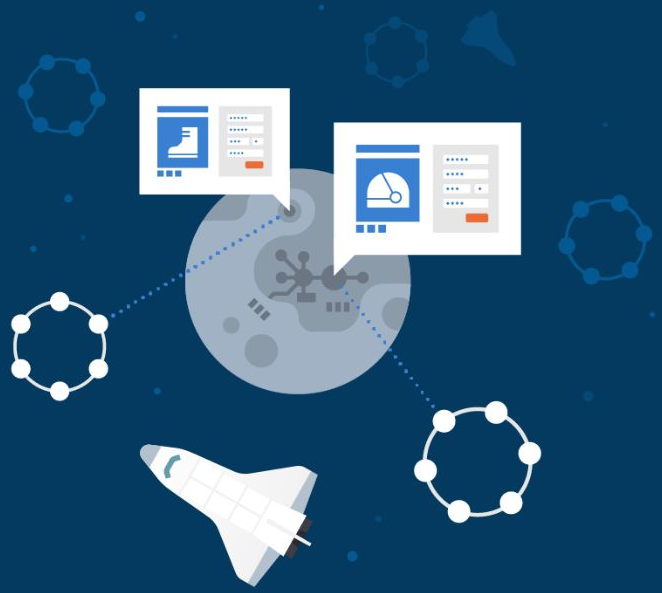


NoSQLBench

A tool with superpowers

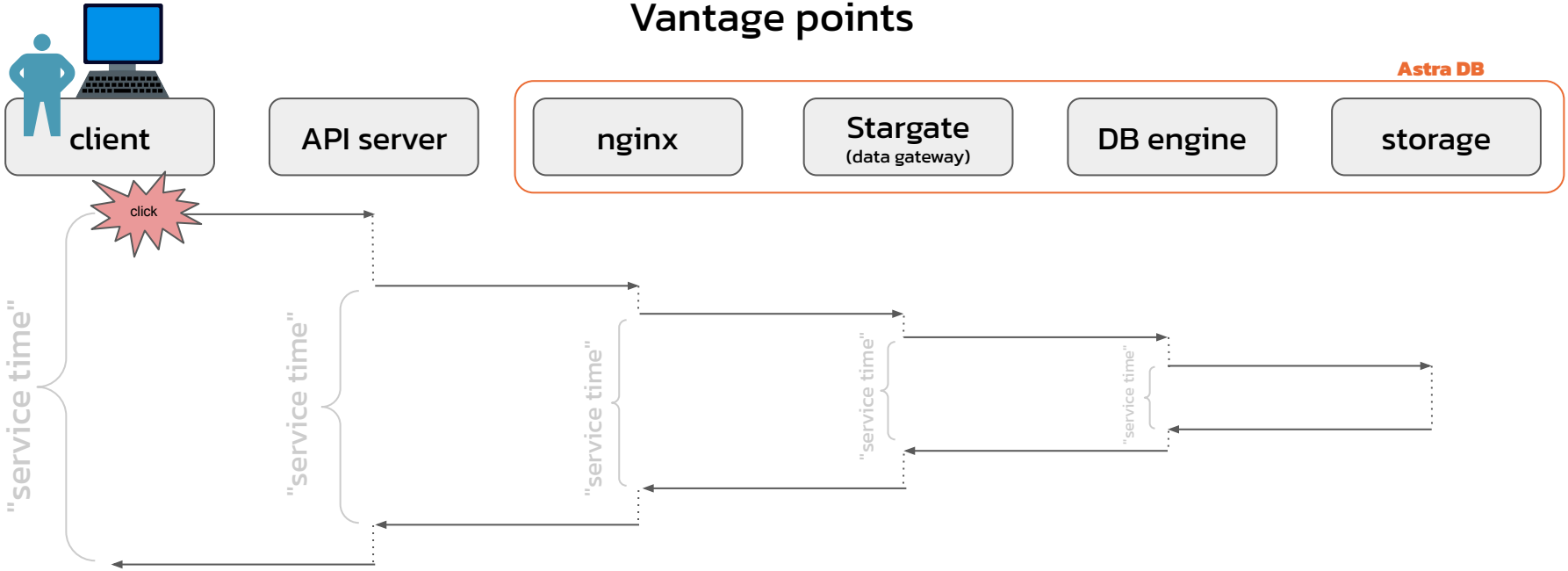
(e2e) performance benchmarking in practice

"A client sending reads/writes to the database and timing everything"

But:

- **realistic synthetic testing**:
  - workload "just like the actual app"...
  - ... but before the app even exists
- reproducible workloads to the details (determinism)
- don't want the client overhead to get in the way of measurements (... not too much)
- distributed system, cloud: where to run the testing client? (just *what* should be tested?)
- the ideal tool: highly customizable but also some off-the-shelf tests (i.e. ready-to-use as they are)

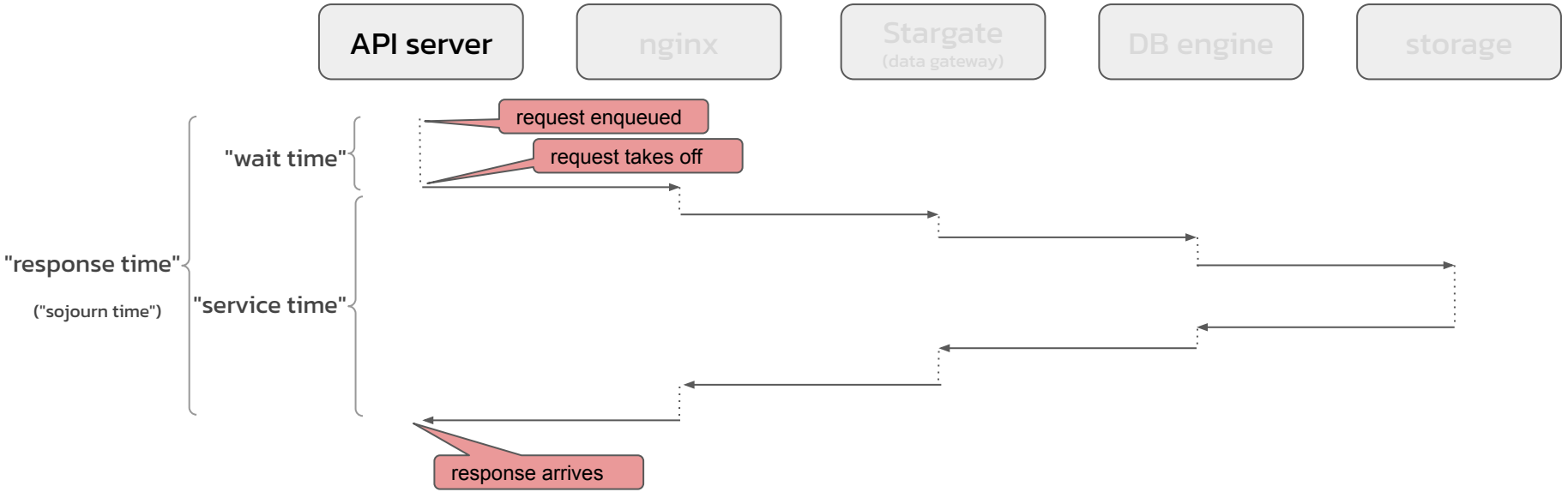
Vantage points



Focus on the "outermost layer" first (users!)

"Latency", for whom?

As seen by the API:

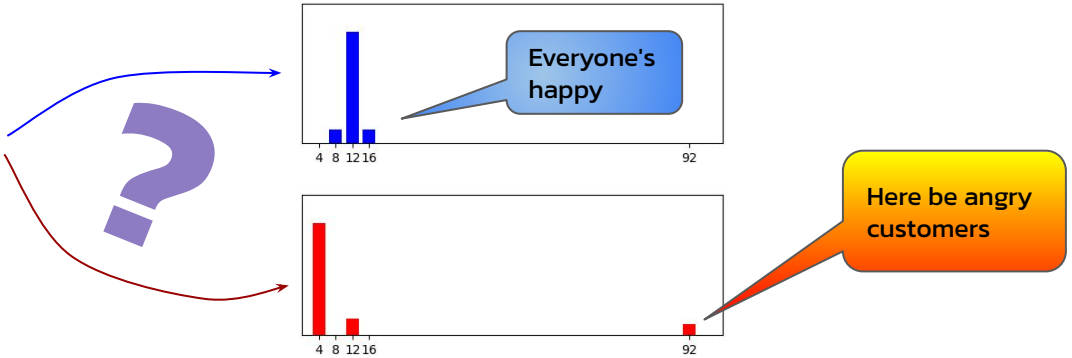


Risk: "coordinated omission" (benchmark bias from congested queue)

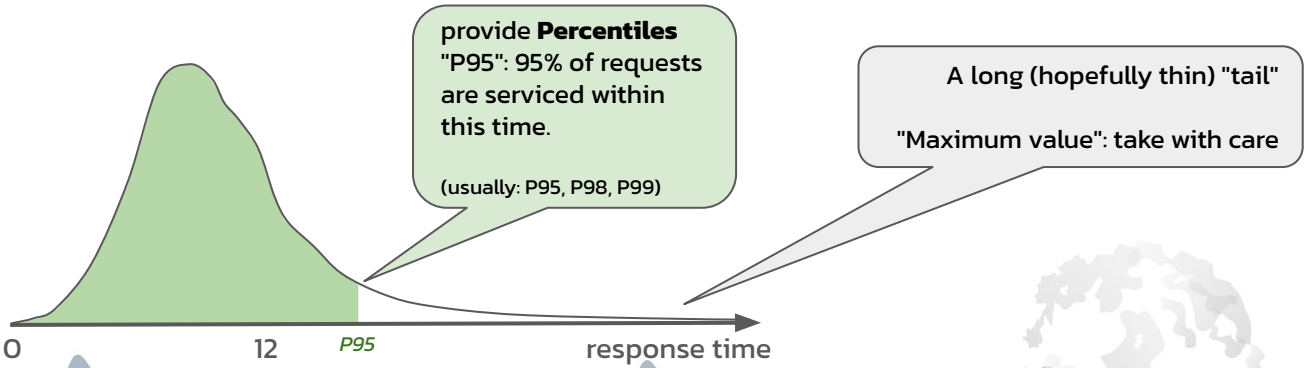
Subtleties with service time

Characterizing performance

"Average response time = 12 ms"



Better: (probability) distributions



Distributions

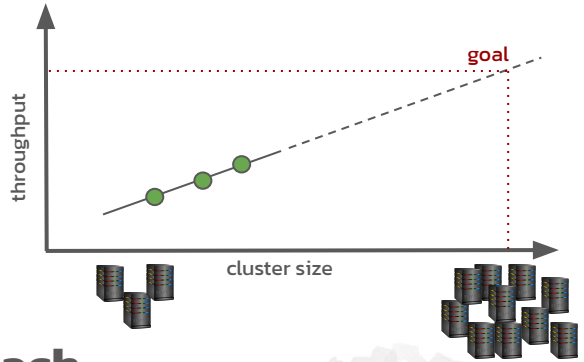
Example approach

"How large the cluster to achieve given **response time** and **throughput** ?"

First: "scale-up" estimate to check response time

Then: "scale-out" analysis + extrapolation

(no need to burn $ with actual scales, just make sure you're in the "scaling regime")



"Vertical-then-horizontal" approach

Overall methodology

Curves & Little's law

$\lambda = L / W$

Average arrival rate in supermarket = (average number of people in it) / (average time spent shopping)

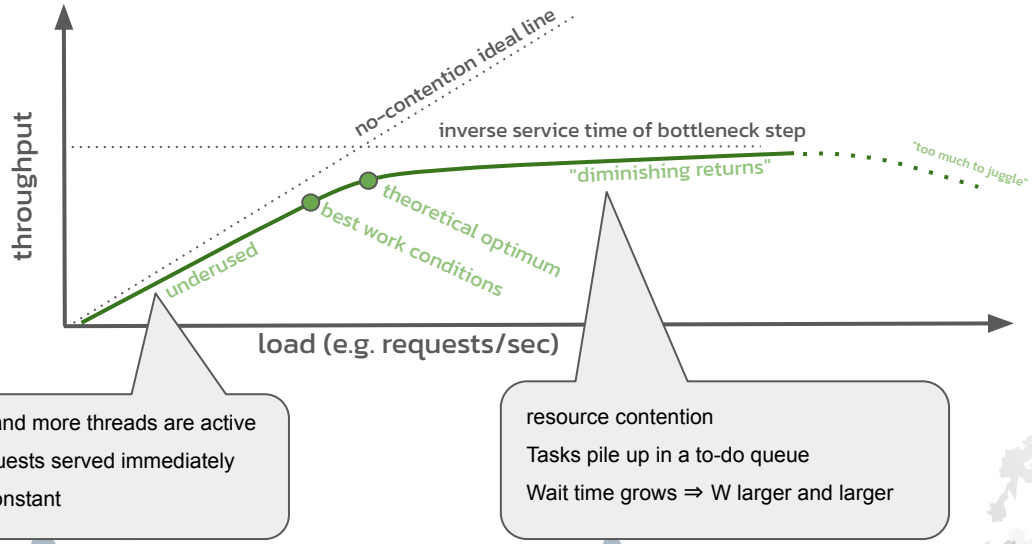
$L = \lambda * W$

Average # requests waiting or being executed = (rate requested for benchmark) * (service time)

$W = L / \lambda$

Average time bottles spend in cellar = (average count of bottles) / (frequency of picking a bottle)

Systematic load testing



more and more threads are active

all requests served immediately

W ~ constant

resource contention

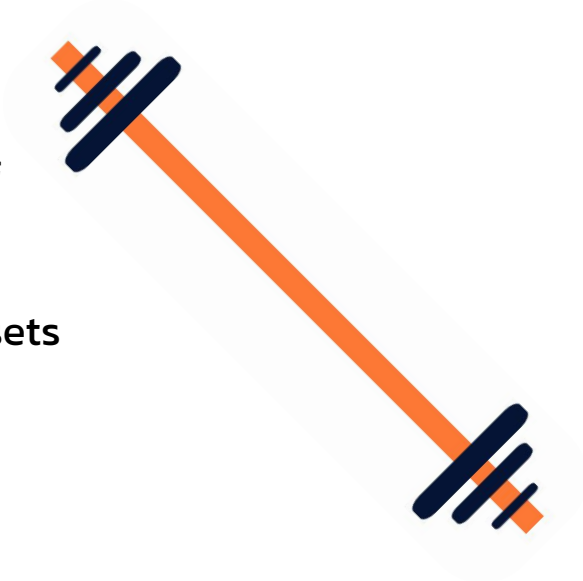
Tasks pile up in a to-do queue

Wait time grows ⇒ W larger and larger

The limits of a system

Some key features

- keeps "coordinated omission" in check
- minimizes impact of measurement infrastructure itself
- metrics to verify client is not overloaded
- Virtual Data Sets, for lightweight, replayable, big data sets
- drivers for many DBs; extensible architecture
- many ways to get and inspect results
- ...



Today's benchmarking tool

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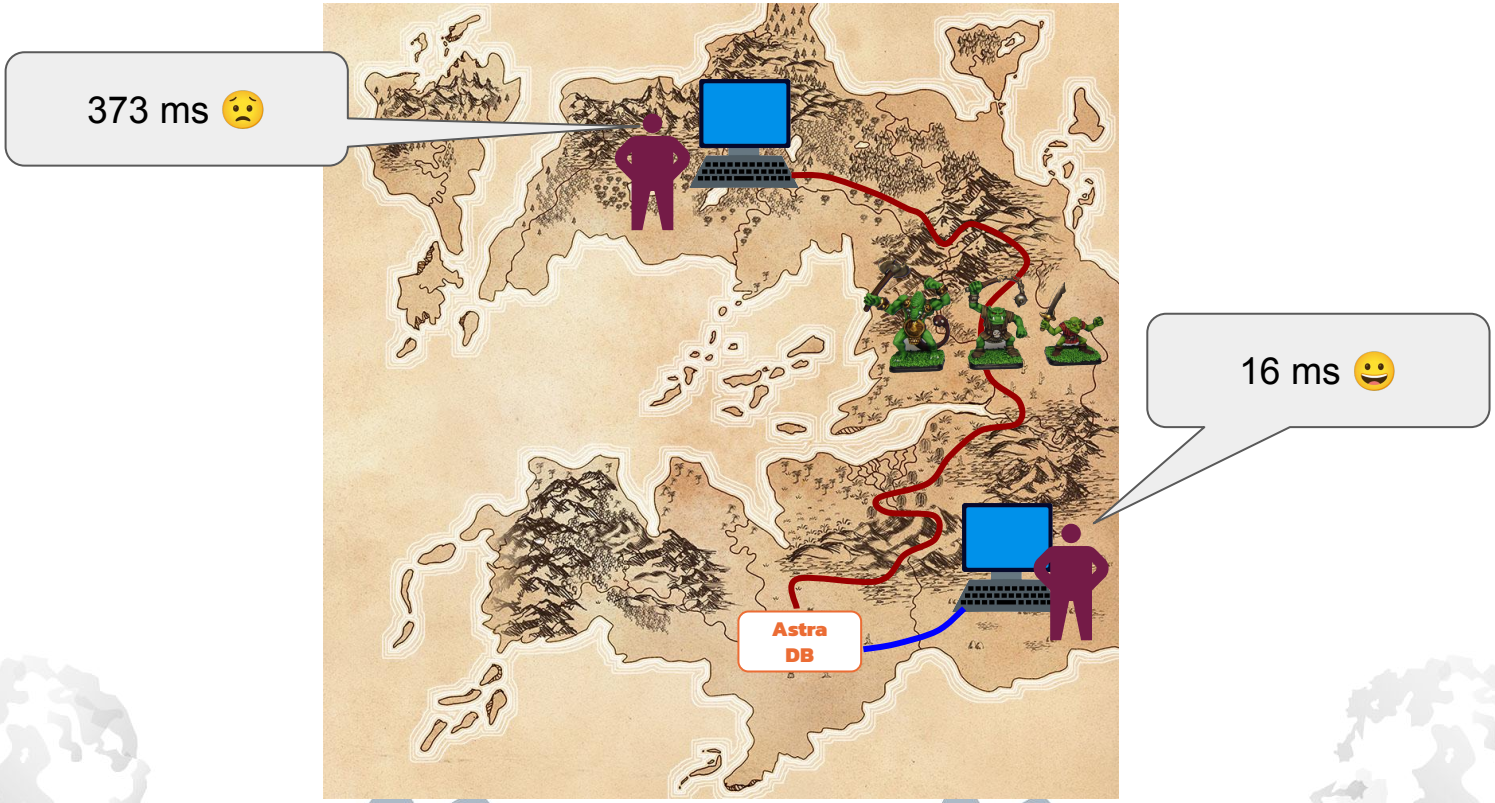
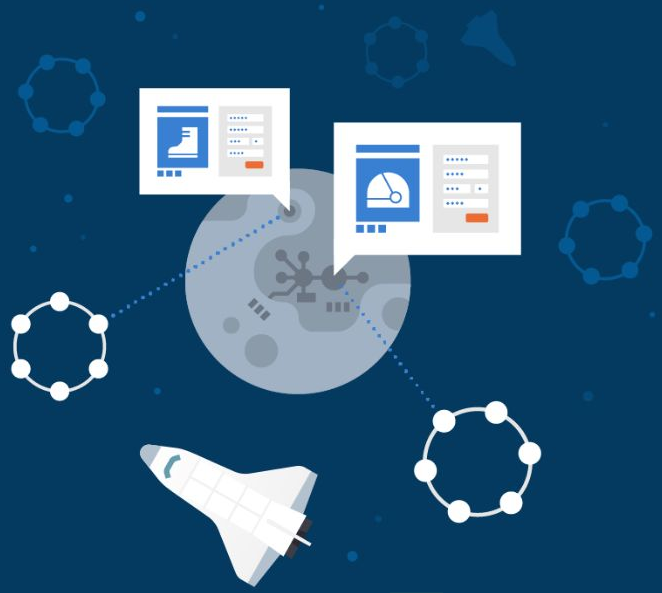
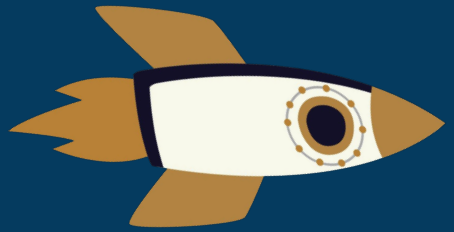
Today: client machines kindly provided by Gitpod. *Where are they?*



A word of caution





Hands-on (!github)

Use NoSQLBench

- ✅ Install & start benchmarks
- ✅ The many ways to inspect results
- ✅ Build custom workloads

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discord.gg/dBHRakusMN

dtsx.io/discord

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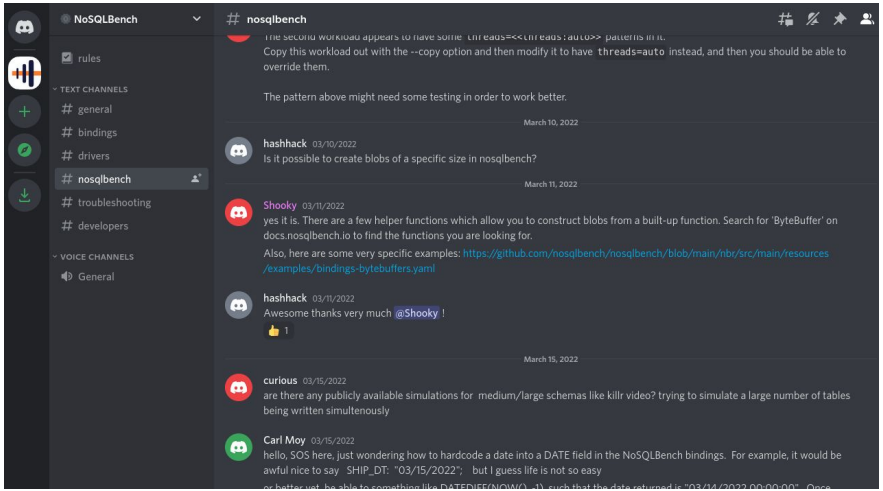
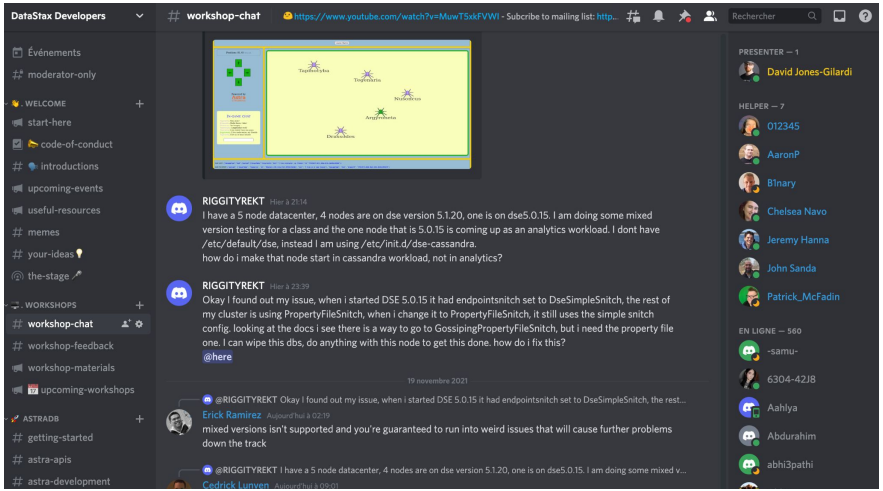
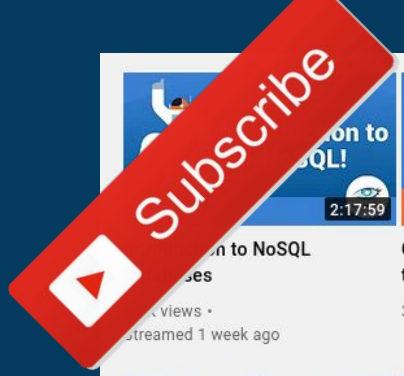
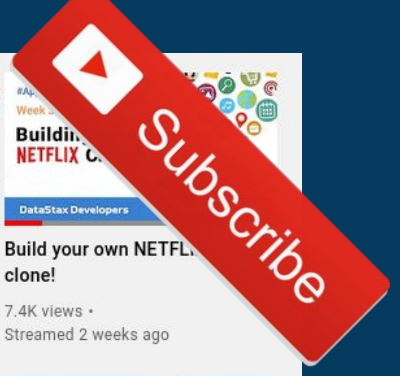




Discord, Discord, Discord





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Data Capture
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Build an
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NoSQL
Bench
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Badges

Thank You!

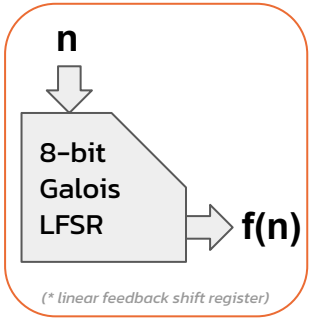
Generating data for benchmarks

We want

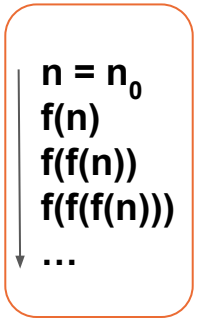
- a huge amount of random-looking data (but: reproducible)
- … without having to store it all, juggle it to/from disk, etc
- … with the ability to retrieve the *n*th value in the sequence in constant time for any *n*

Virtual Data Sets to the rescue!

With this:



build this:



by tuning the LSFR, the sequence spans all the 2^n-1 values in *one cycle* (whatever the nonzero n_0).

Then we can turn this cycle on its head and define:

n*th value in sequence = *f(n)