Experiences from Building the Open Database Performance Ranking with benchANT

13th Symposium on Software Performance 2022

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Advances of **Data Management Technologies** for Data-intensive Applications

- **Web 2.0**
- **Big Data**
- **IoT**

- Physical resources
- Elastic resources

- RDBMS
- NoSQL
- NewSQL
Advances of **Database Technologies** for Data-intensive Applications

Cloud resources have become the preferred solution to operate DBMS

The idea of “one-size-fits-all” is over

DBaaS reached mainstream and serverless DBaaS might be the future

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2 Stonebraker, Michael, and Uğur Çetintemel. “One size fits all” an idea whose time has come and gone.” Making Databases Work: the Pragmatic Wisdom of Michael Stonebraker. 2018
Comparing **Databases**

How to get the required data?

- **Feature Set**
- **Usability**
- **Tooling**
- **Data Mining**
- **Costs**
- **Performance**
- **Scaling**
Promises of **Database Providers**

**Couchbase**

Unparalleled **performance** at scale

**PostgreSQL** is a powerful, open source object-relational database system with over 30 years of active development that has earned it a strong reputation for reliability, feature robustness, and performance.

**TIMESCALE**

**Accelerated performance**

Achieve 10-100x faster queries than PostgreSQL, InfluxDB, and MongoDB. Native optimizations for time-series.

**Influxdata**

A **high-performance** time series engine

**GridDB**

**High Performance**

Utilizing an in-memory data architecture — along with superb parallel processing and minimal overhead — grants benchmark shattering performance.

**SingleStore**

**Speed**

Accelerate time to insight with a database built for ultra fast ingest and high performance queries

**Cassandra**

**Performant**

Cassandra consistently outperforms popular NoSQL alternatives in benchmarks and real applications, primarily because of fundamental architectural choices.
Is Database **Benchmarking** still important?

“Benchmarks tremendously helped move forward the database industry and the database research community.

Moreover, without the development of appropriate benchmarking and data sets, a fair comparison ... will not be feasible. Benchmarking in the cloud environment also presents unique challenges since differences in infrastructure across cloud providers makes apples to apples comparison more difficult. A closely related issue is reproducibility of performance results in database publications.” -- Seattle Report on Database Research 2022

<sup>1</sup>Abadi, Daniel, et al. "The seattle report on database research." ACM SIGMOD Record (2022)
Reproducible Cloud Database Benchmarking

- scientific guidelines for reproducible cloud benchmarking
- scientific guidelines for reproducible cloud-hosted database benchmarking
- leading database and performance engineering conferences enforce available and reproducible benchmarking data sets (VLDB, SIGMOD, ICPE, ...)

**BUT**: Leznik et al. show that only a very limited number of performance related research results release their benchmark results as open data sets

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Experiences from Building a Global Database **Performance** Ranking

How to ensure a fully transparent and reproducible global database performance ranking?

Which insights can you get out of the global database performance ranking?
Requirements for a **Reproducible and Transparent** Cloud Database Ranking

- requirements are derived from the scientific guidelines for cloud and database benchmarking
- imposed by cloud and database providers
- R1: provide raw and aggregated performance data
- R2: provide dynamic configurations for cloud, database and workload domain
- R3: provide monitoring data for all involved components
- R4: enable a performance audit -> which benchmark step $X$ is executed at time $T^x$
benchANT Background
End-to-end Benchmark Automation with Mowgli

- fully automated benchmarking process
- guaranteed transparency by reproducibility
- comprehensive data sets
Automating **Performance & Scalability** Evaluations

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From Mowgli to benchANT — Benchmarking-as-a-Service

Mowgli Framework

Evaluation Designer
Evaluation Specification
Evaluation Execution
Multi-objective Analysis
Analytics Dashboard
From Mowgli to benchANT — Benchmarking-as-a-Service
From Mowgli to benchANT — Benchmarking-as-a-Service

Mowgli Framework

Evaluation Designer

Evaluation Specification

Evaluation Execution

Multi-objective Analysis

Analytics Dashboard

start evaluation
allocate resources
deploy & configure DBMS cluster
select & configure benchmark
execute workload
release resources
process evaluation objective
evaluation finished
Performance Insights

https://benchant.com/ranking/database-ranking
**Insights: Database Performance** (YCSB read-write workload)

<table>
<thead>
<tr>
<th>RANK</th>
<th>DATABASE</th>
<th>CLOUD</th>
<th>THROUGHPUT</th>
<th>READ LATENCY (ms)</th>
<th>WRITE LATENCY (ms)</th>
<th>MONTHLY COSTS ($)</th>
<th>THROUGHPUT (USD)</th>
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**Insights: Database Scalability (YCSB read-write workload)**

<table>
<thead>
<tr>
<th>RANK</th>
<th>DATABASE</th>
<th>CLOUD</th>
<th>THROUGHPUT [ops/s]</th>
<th>READ LATENCY [ms]</th>
<th>WRITE LATENCY [ms]</th>
<th>MONTHLY COSTS [$]</th>
<th>THROUGHPUT PER COST [ops/$]</th>
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# Insights: IaaS Resource Performance & Costs

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<th>THROUGHPUT</th>
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<th>MONTHLY COSTS</th>
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Insights: **DBaaS Performance** (YCSB read-write workload)
Benchmarking Data Structure
Data Set Structure

- **R1**: provide raw and aggregated performance data
  - Raw performance data for the load and run phase is provided as time-series and aggregated

- **R2**: provide dynamic configurations for cloud, database and workload domain
  - Configurable benchmark parameters are defined in a model (`evaluationScenario.json`)
  - Cloud & VM & database configurations are collected

- **R3**: provide monitoring data for all involved components
  - System metrics for database and benchmark instances are collected

- **R4**: enable a performance audit -> which benchmark step X is executed at time T
  - A task execution log for all executed benchmark steps is provided (`airflowTaskInstanceDetails.json`)
Data Set Structure

- All data is available on GitHub: [https://github.com/benchANT/database-ranking](https://github.com/benchANT/database-ranking)
- Reproducibility of the results is validated by multiple database providers.
- Validation was carried out by using the benchANT platform and by executing the benchmarks manually based on the publicly available data sets.
Conclusion

- Database benchmarking is still a highly relevant task to advance database research while cloud computing adds another level of complexity.
- Database benchmarking needs to ensure reproducible and transparent data sets, currently only a limited number of benchmarking studies follow these requirements.
- Based on a global database performance ranking, we provide a reference data set structure for reproducible and transparent performance results.
- Reproducibility is validated by multiple database providers.
- Comprehensive performance data sets are the foundation for advanced database research, such as configuration auto-tuning.
Thank you!

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