Automated Benchmarking of Cloud-hosted DBMS with benchANT

12th Symposium on Software Performance 2021

Daniel Seybold, Jörg Domaschka
benchANT | Ulm University
Advances of **Data Management Technologies** for Data-intensive Applications
Advances of **Data Management Technologies** for Data-intensive Applications

Cloud resources have become the preferred solution to operate DBMS\(^1\)

The idea of "one-size-fits-all" is over\(^2\)

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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
Decision Making in the **Cloud DBMS** World

**PLETHORA OF CLOUD & DBMS**
**RAPIDLY EVOLVING TECHNOLOGIES**
**NO UP-TO-DATE DATA**
Decision Making in the Cloud DBMS World

PLETHORA OF CLOUD & DBMS RAPIDLY EVOLVING TECHNOLOGIES NO UP-TO-DATE DATA

"... we recommend measuring the performance of applications to identify appropriate instance types ... we also recommend rigorous load/scale testing ..." – AWS
https://aws.amazon.com/ec2/instance-types/

"... measure everything, assume nothing ...“ – MongoDB
Benchmarking DBMS in the Pre-Cloud Era vs. Cloud Era
Benchmarking DBMS in the Pre-Cloud Era vs. Cloud Era
Benchmarking Cloud-hosted DBMS with benchANT
Benchmarking Cloud-hosted DBMS with benchANT

Evaluation Specification
Evaluation Execution
Multi-objective Analysis
Evaluation Designer
Evaluation Specification
Evaluation Execution
Multi-objective Analysis
Analytics Dashboard

Mowgli, Kaa & King Louie

1 https://research.spec.org/tools/overview/mowgli/
2 Seybold, D. 2021. An automation-based approach for reproducible evaluations of distributed DBMS on elastic infrastructures. Universität Ulm
LIVE-DEMO
Continuous Benchmarking with benchANT
Continuous Benchmarking with benchANT

Fitting database technology

Cloud Provider strengths

Medium and Long-term requirements

Foreplanning

Capacity Planning

Cloud & Database Selection

Performance Tuning

Version Monitoring

Lower Cloud TCO

Right-sized resources

New Cloud offers

New database releases

Faster configurations

Performance improvements

DEV

OPS
Version Monitoring Insights:
New DBMS Release = Better Performance?
Version Monitoring Insights:
New DBMS Release = Better Performance?
Version Monitoring Insights:
New DBMS Release = Better Performance?
Cloud Provider Selection Insights:
Similar VM Flavours = Similar Performance?

DBMS spec:
MongoDB
3 nodes

VM spec:
2 cores
8GB RAM
cheapest storage option

Workload Spec:
YCSB
80% writes
20% reads
Cloud Provider Selection Insights:
Always choose SSD over HDD for Write Performance?
<table>
<thead>
<tr>
<th>Feature Set</th>
<th>ALPHA Release</th>
</tr>
</thead>
</table>

### DBMS
- MongoDB
- Cassandra
- Couchbase
- PostgreSQL
- MySQL
- Cockroach DB

### Cloud
- AWS
- Azure
- Open Telekom Cloud
- IONOS
- Openstack

### Benchmark
- Yahoo Cloud Serving Benchmark (YCSB)

### KPIs
- Throughput
- Write Latency
- Read Latency
- Storage Allocation
- Cloud Costs
benchmarking Any New Technology

Trace-based DBMS workloads

AI-based recommender system

benchANTS Benchmarking-as-a-Service technology

DATABASES
On Public & Private Cloud

STORAGE
On Public & Private Cloud

AI
On Public & Private Cloud

SERVERLESS
On Public Cloud

ALPHA
2022
2023
2024
We are looking for pilot projects & research collaborations!
benchANT is built upon

1 PhD

> 15 years of research

> 10 scientific papers

scientific awards and results

Cloud Research
- Kaa: Evaluating elasticity of cloud-hosted DBMS (CloudCom 2019)
- The impact of the storage tier: A baseline performance analysis of containerized DBMS (Euro-Par 2017)

Performance Engineering Research
- Baloo: Measuring and modeling the performance configurations of distributed DBMS (MACOTS 2020)
- Mowgli: Finding your way in the DBMS jungle (ICPE 2019)
- Towards Understanding the Performance of Distributed Database Management Systems in Volatile Environments (SSP 2019)

DBMS Research
- King Louie: Reproducible availability benchmarking of cloud-hosted DBMS (SAC 2020)
- Is distributed database evaluation cloud-ready? (ADBIS 2017)
- Is elasticity of scalable databases a myth? (Big Data 2016)
The team behind benchANT
Researchers & Innovators

Dr. Daniel Seybold
Technology & Development
PhD on Cloud Database Benchmarking
Cloud-Database Performance (6 years)

Jan Ocker
Operations, Finance & Market
Dipl. phys. oec. (Physics & Economy)
eCommerce experience
project manager & Business Development (7 years)

Dr. Jörg Domaschka
Consulting, Sales & HR
PhD Computer Science
Cloud-Research (16 years)
IT Consultant (2 years)

Funding

Supporters
Demo Backup
Demo
Configurator

Datenbank-Konfiguration

Neue Konfiguration hinzufügen

1. WÄHLE DATENBANK: Cassandra
   - MongoDB
   - Cassandra
   - Couchbase
   - CouchDB
   - MySQL
   - PostgreSQL

2. WÄHLE VERSION

3. WÄHLE CLUSTER-GRÖSSE: Bitte schließen Sie den vorherigen Schritt ab, um fortzufahren

4. WÄHLE REPLIKATIONSSRÄD: Bitte schließen Sie den vorherigen Schritt ab, um fortzufahren

Konfiguration löschen
Konfiguration speichern
Demo Configurator

Cloud-Konfiguration

Neue Konfiguration hinzufügen

1. WÄHLE PROVIDER
   - FTP
   - AWS
   - IONOS
   - Telecom
   - Azure

2. WÄHLE CLOUD-REGION
   - Bitte schließen Sie den vorherigen Schritt ab, um fortzufahren!

3. WÄHLE VM-FLAVOR
   - Bitte schließen Sie den vorherigen Schritt ab, um fortzufahren!

Konfiguration löschen
Konfiguration anpassen
Demo
Configurator

Workload-Konfiguration

Neue Konfiguration hinzufügen

1. WÄHLE BENCHMARK
   YCSB
   Beschreibung: read only for caching
   Verteilung: zipfian
   Anzahl der Datensätze: 50
   Read/Write-Verhältnis: 100
   Datensatzgröße: 20 KB
   Throug: 50

2. WÄHLE WORKLOAD
   IoT
   Ecommerce
   Social Media
   Caching
   ML
   custom

Konfiguration löschen
Konfiguration speichern
### Auswahl

<table>
<thead>
<tr>
<th>DATABASE</th>
<th>CLOUD</th>
<th>BENCHMARK</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Cassandra</strong></td>
<td>IONOS</td>
<td>YCSB</td>
</tr>
<tr>
<td>Version: 3.9</td>
<td>Standort: us/las</td>
<td>Workload: IoT</td>
</tr>
<tr>
<td>Cluster-Größe: 3</td>
<td>Flavor: 1c_OPTERON_4r</td>
<td></td>
</tr>
<tr>
<td>Replikationen: 2</td>
<td></td>
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<tbody>
<tr>
<td>Version: 3.9</td>
<td>Standort: eu-west-2</td>
<td>Workload: IoT</td>
</tr>
<tr>
<td>Cluster-Größe: 3</td>
<td>Flavor: m5g.medium</td>
<td></td>
</tr>
<tr>
<td>Replikationen: 2</td>
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</table>
### Ranking Overview

Select setups for performance details. Detailed charts are visualised interactively below the table. Hover over data points to get more information. Setups are sorted by the benchANT Score.

<table>
<thead>
<tr>
<th>benchANT Score</th>
<th>CONFIG ID</th>
<th>DBMS</th>
<th>CLOUD</th>
<th>BENCHMARK</th>
</tr>
</thead>
</table>
| 19             | telekomm-mongodb-64-threads-s3.large-ssd | type: MONGODDB  
version: 4.4.2  
nodes: 3.0  
replication factor: 3.0 | provider: TELEKOM  
region: eu-de  
flavor: m3.large  
storage: SSD | type: YCSB  
write proportion: 0.8  
read proportion: 0.2  
request distribution: ZIPF90 |
| 16             | telekomm-mongodb-64-threads-c4.large-ssd | type: MONGODDB  
version: 4.4.2  
nodes: 3.0  
replication factor: 3.0 | provider: TELEKOM  
region: eu-de  
flavor: m4.large  
storage: SSD | type: YCSB  
write proportion: 0.8  
read proportion: 0.2  
request distribution: ZIPF90 |
| 14             | ec2-m5.large-mongodb-64-threads | type: MONGODDB  
version: 4.4.2  
nodes: 3.0  
replication factor: 3.0 | provider: EC2  
region: eu-west-1  
flavor: m5.large  
storage: GP2 | type: YCSB  
write proportion: 0.8  
read proportion: 0.2  
request distribution: ZIPF90 |
| 13             | ionos-intel-xeon-mongodb-64-threads | type: MONGODDB  
version: 4.4.2  
nodes: 3.0  
replication factor: 3.0 | provider: Ionos  
region: us-east  
flavor: 3c8XeonFr  
storage: SSD | type: YCSB  
write proportion: 0.8  
read proportion: 0.2  
request distribution: ZIPF90 |
| 13             | ionos-xeom-mongodb-SSD-2000GB | type: MONGODDB  
version: 4.4.2  
nodes: 3.0  
replication factor: 3.0 | provider: Ionos  
region: us-east  
flavor: 3c8XeonFr  
storage: SSD | type: YCSB  
write proportion: 0.8  
read proportion: 0.2  
request distribution: ZIPF90 |
| 13             | ionos-xeom-mongodb-SSD-4000GB | type: MONGODDB  
version: 4.4.2  
nodes: 3.0  
replication factor: 3.0 | provider: Ionos  
region: us-east  
flavor: 3c8XeonFr  
storage: SSD | type: YCSB  
write proportion: 0.8  
read proportion: 0.2  
request distribution: ZIPF90 |
| 13             | ec2-m5.large-mongodb-64-threads | type: MONGODDB  
version: 4.4.2  
nodes: 3.0  
replication factor: 3.0 | provider: EC2  
region: eu-west-1  
flavor: m5.large  
storage: GP2 | type: YCSB  
write proportion: 0.8  
read proportion: 0.2  
request distribution: ZIPF90 |
| 12             | ionos-intel-xeon-mongodb-64-threads | type: MONGODDB  
version: 4.4.2  
nodes: 3.0  
replication factor: 3.0 | provider: Ionos  
region: de-de  
flavor: 3c8XeonFr  
storage: SSD | type: YCSB  
write proportion: 0.8  
read proportion: 0.2  
request distribution: ZIPF90 |
| 12             | ionos-intel-xeon-mongodb-64-threads | type: MONGODDB  
version: 4.4.2  
nodes: 3.0  
replication factor: 3.0 | provider: Ionos  
region: de-de  
flavor: 3c8XeonFr  
storage: SSD | type: YCSB  
write proportion: 0.8  
read proportion: 0.2  
request distribution: ZIPF90 |
| 11             | telekomm-mongodb-64-threads | type: MONGODDB  
version: 4.4.2  
nodes: 3.0  
replication factor: 3.0 | provider: TELEKOM  
region: ec-eu  
flavor: m3.large  
storage: SSD | type: YCSB  
write proportion: 0.8  
read proportion: 0.2  
request distribution: ZIPF90 |
Demo Dashboard

m-mongodb-64-threads-s3.large-m-mongodb-64-threads-c4.large-c2-m5.large-mongodb-64-thread

ionos_intel-xeon-mongodb-hdd onos_xeon-mongodb-SSD-200G onos_xeon-mongodb-SSD-400G

...
Demo Dashboard
Demo Dashboard
Demo Dashboard

Cloud Provider Metadata

VM Metadata

MONGODB Metadata