o Some valid criticisms about how the benchmark is set up and possible bias in reporting.
o However, overall it's salty & misses some of the things that were key to memgraph's design of benchgraph.

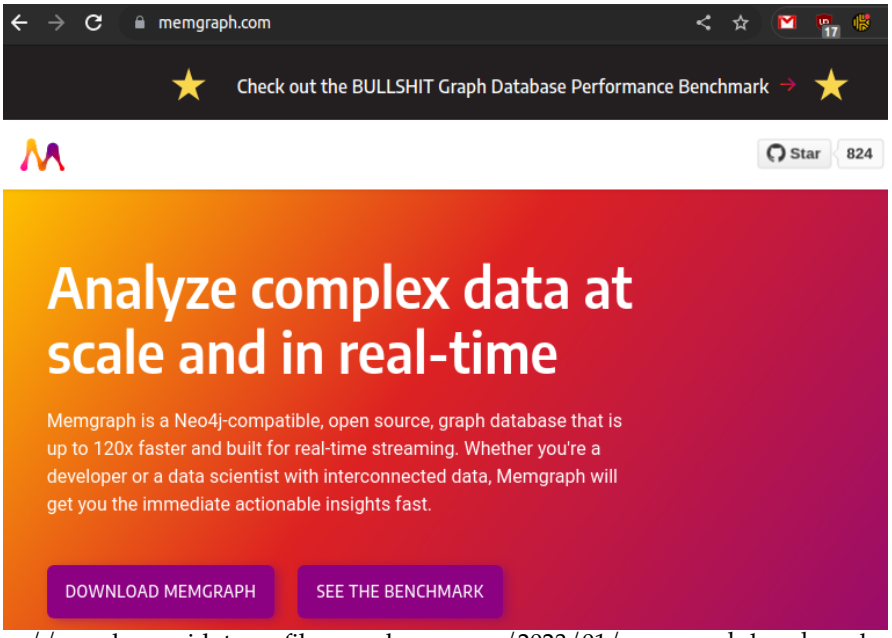
Max De Marzi

Graphs, Graphs, and nothing but the Graphs

JAN 11 2023

4 COMMENTS
BY MAXDEMARZI CYPHER, TESTING

Bullshit Graph Database Performance Benchmarks



(https://maxdemarzidotcom.files.wordpress.com/2023/01/memgraph-benchmark.png)

Hey HackerNews (https://news.ycombinator.com/item?id=34342371), let me just drop my mixtape (http://ragedb.com/), checkout my soundcloud (https://github.com/ragedb/ragedb) and "Death Row" is the label that pays me (https://relational.ai/).

How is the Graph Database category supposed to grow when vendors keep spouting off complete bullshit (https://www.youtube.com/watch?v=XPrRxhYJMkQ)? I wrote a bit (https://maxdemarzi.com/2022/12/06/khop-baby-one-more-time/) about the ridiculous benchmark (https://memgraph.com/benchgraph) Memgraph published last month hoping they would do the right thing and make an attempt at a real analysis. Instead these clowns put it on a banner on top of their home page. So let's tear into it.

At first I considered replicating it using their own repository (https://github.com/memgraph/memgraph/tree/master/tests/mgbench), but it's about 2000 lines of Python and I don't know Python. Worse still, the work is under a "Business Source License" which states:

> "Authorised Purpose" means any of the following, provided always that (a) you do not embed or otherwise distribute the Licensed Work to third parties; and (b) you do not provide third parties direct access to operate or control the Licensed Work as a standalone solution or service:
>
> 1…
>
> 2….
>
> 3. using the Licensed Work to create a work or solution which competes (or might reasonably be expected to compete) with the Licensed Work.

https://github.com/memgraph/memgraph/blob/master/licenses/BSL.txt (https://github.com/memgraph/memgraph/blob/master/licenses/BSL.txt) IANAL (https://en.wikipedia.org/wiki/IANAL), but that sounds like you aren't allowed to use their benchmark code if you provide a competing solution. Which means the other database vendors can't actually use this anyway. Why would they do this? Because it's a bullshit benchmark and they don't actually want anybody looking too deeply at it.

So I decided to just do a simple project using Gatling (https://gatling.io/). An industry standard tool to test performance. Why doesn't everybody just do that instead of creating their own weird thing that is probably full of problems? Oh right, because everyone produces bullshit benchmarks.

They decided to provide the data not in a CSV file like a normal human being would, but instead in a giant cypher file (https://s3.eu-west-1.amazonaws.com/deps.memgraph.io/dataset/pokec/benchmark/pokec_medium_import.cypher) performing individual transactions for each node and each relationship created. Not batches of transactions (https://neo4j.com/developer-blog/updated-efficient-neo4j-data-import-using-cypher-scripts/)… but rather painful, individual, one at a time transactions one point 8 million times. So instead of the import taking 2 minutes, it takes hours. Why would they do this? I keep forgetting… because they don't actually want anybody trying this.

They are streaming DB; this is fair.

Ok, what's their hardware for the benchmark results?

(https://maxdemarzidotcom.files.wordpress.com/2023/01/memgraph-spec.png)

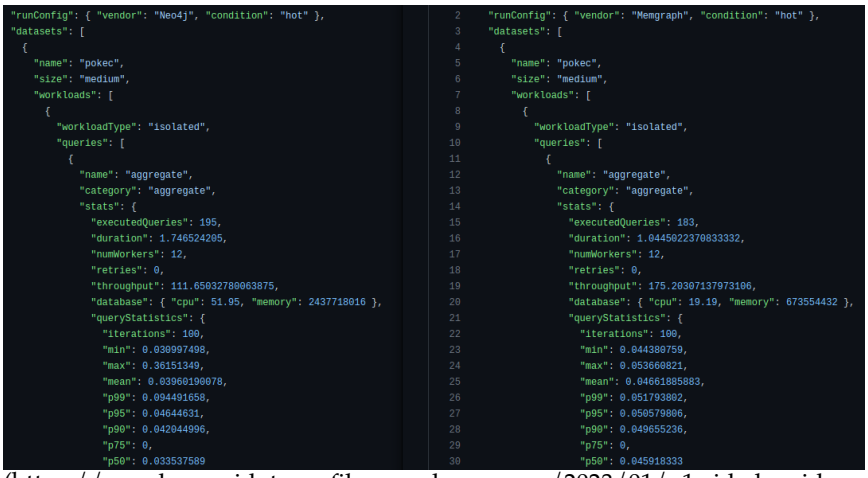
A G6? I'm feeling so fly like a G6 (https://www.youtube.com/watch?v=w4s6H4ku6ZY). Those came out in 2009 (https://proliant.blogspot.com/2009/04/proliant-g6-launch-information.html). I would go on ebay (https://www.ebay.com/sch/i.html?_from=R40&_trksid=p2380057.m570.l1313&_nkw=HP+DL360+G6&_sacat=0) and buy a refurbished one for $50 bucks, but I don't have a rack to put it in and no guarantee it won't catch on fire the second I turn it on. I'll just use my gaming pc (https://nzxt.com/) with an Intel® Core™ i7-10700K CPU @ 3.80GHz × 8 cores. Debian 4.19… uh… they can't mean that, they probably mean Debian 10 (https://en.wikipedia.org/wiki/Debian_version_history#Debian_10_(Buster)) with Linux kernel 4.19. I'll stick with Ubuntu 22.04 with Linux kernel 6.0.5.

Well use the medium dataset (which already takes hours to import the way they set it up) from a "hot engine". Has anyone ever tried testing the performance of a sports car with a "cold engine"? No, because that's stupid, so we won't do that here. Alright the first 4 queries are:

It's "Worst-Case"

```
Q1: MATCH (n:User) RETURN n.age, COUNT(*)
Q2: MATCH (n) RETURN count(n), count(n.age)
Q3: MATCH (n:User) WHERE n.age >= 18 RETURN n.age, COUNT(*)
Q4: MATCH (n) RETURN min(n.age), max(n.age), avg(n.age)
```

Those are not "graphy" queries at all, why are they in a graph database benchmark? Ok, whatever. Let's take a look at the raw data for the first query [neo4j (https://github.com/memgraph/benchgraph/blob/main/results/neo4j_hot.json) and memgraph (https://github.com/memgraph/benchgraph/blob/main/results/memgraph_hot.json)]:



(https://maxdemarzidotcom.files.wordpress.com/2023/01/q1-side-by-side.png)
On the left we have Neo4j, on the right we have Memgraph. Neo4j executed the query 195 times, taking 1.75 seconds and Memgraph 183 times taking 1.04 seconds. Why would you execute the query for different amount of times or different durations of time? That makes no sense. In a proper benchmark you would run each and every query for at least 60 seconds, preferably more and then compare. They do a little division and come up with 112 requests per second for Neo4j and 175 for Memgraph:

Throughput (Queries per second) — Higher throughput, better performance.

Queries included in test		Memgraph		Neo4j
Aggregate Queries				
Q1	aggregate	×1.57	175	112
Q2	aggregate_count	×2.11	272	129
Q3	aggregate_with_filter	×1.55	137	88
Q4	min_max_avg	×1.29	125	97

(https://maxdemarzidotcom.files.wordpress.com/2023/01/memgraph-benchmark-q1-q4.png)
However, the CPUs of both systems were not at 100% meaning they were not fully utilized. The query statistics part is also weird. **"iterations":100**... wait a minute, no they didn't… they did not take 100 additional queries with a single worker separate from the queries they used for throughput and generate "p" latencies in the most idiotic way possible. Yes they did. But of course they did (https://github.com/memgraph/memgraph/blob/eda5213d950e4cf4f8c81d6eee8963fa0596ffa6/tests/mgbench/benchmark.py#L243):

```python
for i in range(0, iteration):
    ret = client.execute(queries=[query_list[i]], num_workers=1)
    latency.append(ret[0]["duration"])
latency.sort()
query_stats = {
    "iterations": iteration,
    "min": latency[0],
    "max": latency[iteration - 1],
    "mean": statistics.mean(latency),
    "p99": latency[math.floor(iteration * 0.99) - 1],
    "p95": latency[math.floor(iteration * 0.95) - 1],
    "p90": latency[math.floor(iteration * 0.90) - 1],
    "p75": latency[math.floor(iteration * 0.75) - 1],
    "p50": latency[math.floor(iteration * 0.50) - 1],
}
```

Latency, p99 (Milliseconds) — Lower latency is better.

Queries included in test		Memgraph		Neo4j
Aggregate Queries				
Q1	aggregate	×1.82	51.79	94.49
Q2	aggregate_count	×2.79	31.96	89.07
Q3	aggregate_with_filter	×1.66	61.25	101.41
Q4	min_max_avg	×2.87	72.33	207.68

(https://maxdemarzidotcom.files.wordpress.com/2023/01/memgraph-benchmark-q1-q4-latencies.png)

You know what's also weird? They reported the *p99* of only 100 queries which could be high for any number of reasons, but not the *mean* latency. Why not? Because in the *mean* latency Neo4j comes in at *39.6ms* vs *46.6ms* for Memgraph. **Neo4j is actually faster** if we look at the other metrics. The *p95*, *p90*, *p50* and *min* are all faster for Neo4j. Talk about an egg on your face (https://www.youtube.com/watch?v=2QCB8KA2NdI).

(https://maxdemarzidotcom.files.wordpress.com/2023/01/q1-mean.png)
At this point I haven't even ran a single of my own tests and I can dismiss this benchmark as Gigli bad (https://en.wikipedia.org/wiki/Gigli). Ok, let's try running query 1 for 60 seconds using 8 workers since I only have 8 cores vs their 12 and see what Gatling tells us:

Expand all groups | Collapse all groups

Requests	Executions					Response Time (ms)							
	Total	OK	KO	% KO	Cnt/s	Min	50th pct	75th pct	95th pct	99th pct	Max	Mean	Std Dev
All Requests	31866	31866	0	0%	531.1	14	14	15	18	28	82	15	3
Q1 - aggregate	31866	31866	0	0%	531.1	14	14	15	18	28	82	15	3

(https://maxdemarzidotcom.files.wordpress.com/2023/01/q1-neo-max.png)
Instead of 112 queries per second, I get 531q/s. Instead of a p99 latency of 94.49ms, I get 28ms with a min, mean, p50, p75 and p95 of 14ms to 18ms. Alright, what about query 2? Same story.

Expand all groups | Collapse all groups

Requests	Executions					Response Time (ms)							
	Total	OK	KO	% KO	Cnt/s	Min	50th pct	75th pct	95th pct	99th pct	Max	Mean	Std Dev
All Requests	41888	41888	0	0%	698.133	10	11	11	14	22	48	11	2
Q2 - aggregate_count	41888	41888	0	0%	698.133	10	11	11	14	22	48	11	2

(https://maxdemarzidotcom.files.wordpress.com/2023/01/q2-neo-max.png)
Let's see the rest:

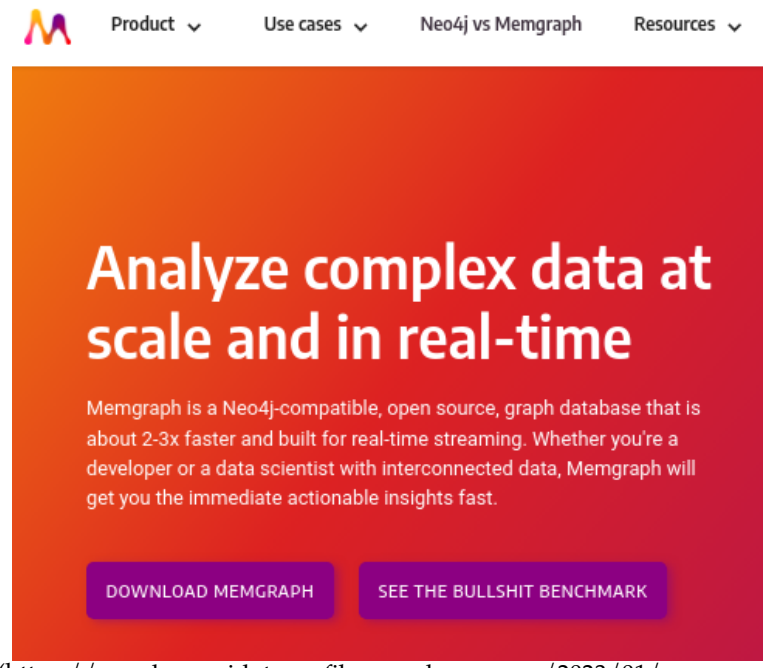
	Requests		Response Time (ms)						
	Total	Cnt/s	Min	50th	75th	95th	99th	Max	Mean
Q1 - aggregate	31866	531.1	14	14	15	18	28	82	15
Q2 - aggregate_count	41888	698.133	10	11	11	14	22	48	11
Q3 - aggregate_with_f…	30820	505.246	14	15	15	18	28	95	16
Q4 - min_max_avg	31763	529.383	14	14	15	19	28	81	15
Q5 - expansion_1	615698	10093.41	0	1	1	1	2	90	1
Q6 - expansion_1_with…	615168	10084.721	0	1	1	1	2	64	1
Q7 - expansion_2	57683	945.623	0	2	7	41	81	583	8
Q8 - expansion_2_with…	109390	1793.279	0	1	4	17	41	252	4
Q9 - expansion_3	3027	49.623	0	95	233	552	733	1028	159
Q10 - expansion_3_wit…	4832	79.213	0	59	148	328	479	803	99
Q11 - expansion_4	226	3.054	1	888	2157	9194	22886	25890	2261
Q12 - expansion_4_wit…	247	3.087	1	679	2026	8584	21703	24169	2138
Q13 - neighbours_2	56106	919.77	0	2	8	42	84	367	8
Q14 - neighbours_2_wit	105232	1725.115	0	1	5	18	43	328	4
Q15 - neighbours_2_wi…	32580	534.098	0	5	15	68	121	385	15
Q16 - neighbours_2_wi…	60791	996.574	0	4	10	27	61	414	8
Q17 - pattern_cycle	523845	8587.623	0	1	1	2	3	82	1
Q18 - pattern_long	602254	9873.016	0	1	1	1	2	31	1
Q19 - pattern_short	616306	10103.377	0	1	1	1	2	20	1
Q20 - single_edge_wri…	242302	3972.164	1	2	2	3	6	32	2
Q21 - single_vertex_w…	284782	4668.557	1	2	2	2	5	75	2
Q22 - single_vertex_p…	9646	158.131	39	49	51	58	71	139	49
Q23 - single_vertex_r…	614535	10074.344	0	1	1	1	2	109	1

Those numbers are wildly different than the numbers Memgraph calculated for Neo4j in their benchmark. Let's see the breakdown:

	Memgraph	Neo4j reported	mine	Winner	By
Q1 - aggregate	175	112	531	Neo4j	3.03*
Q2 - aggregate_count	272	129	698	Neo4j	2.56*
Q3 - aggregate_with_filter	137	88	505	Neo4j	3.68*
Q4 - min_max_avg	125	97	529	Neo4j	4.23*
Q5 - expansion_1	29648	517	10093	Memgraph	2.93
Q6 - exp_1_with_filter	31553	467	10085	Memgraph	3.12
Q7 - expansion_2	2164	30	946	Memgraph	2.29
Q8 - exp_3_with_filter	3603	61	1793	Memgraph	2.01
Q9 - expansion_3	134	7	50	Memgraph	2.68
Q10 - exp_3_with_filter	159	12	79	Memgraph	2.01
Q11 - expansion_4	4	1	3	Memgraph	1.33
Q12 - exp_4_with_filter	5	2	3	Memgraph	1.66
Q13 - neighbours_2	2171	59	920	Memgraph	2.36
Q14 - n2_with_filter	727	48	1725	Neo4j	2.37*
Q15 - n2_with_data	1286	43	534	Memgraph	2.40
Q16 - n2_w_data_and_filter	3453	83	997	Memgraph	3.46
Q17 - pattern_cycle	21718	371	8588	Memgraph	2.53
Q18 - pattern_long	33130	1127	9873	Memgraph	3.36
Q19 - pattern_short	36187	1508	10103	Memgraph	3.58
Q20 - single_edge_write	32211	337	3972	Memgraph	8.11
Q21 - single_vertex_write	35172	557	4669	Memgraph	7.53
Q22 - s_v_property_update	239	106	158	Memgraph	1.51
Q23 - single_vertex_read	36843	1841	10074	Memgraph	3.66

It looks like Neo4j is faster than Memgraph in the Aggregate queries by about 3 times. Memgraph is faster than Neo4j for the queries they selected by about 2-3x except for *query 14* where Neo4j plays the Uno Reverse card (https://knowyourmeme.com/memes/uno-reverse-card). I checked it multiple times, it is correct.

So there you have it folks. Memgraph is not up to 120 times faster than Neo4j… let's fix their home page:



(https://maxdemarzidotcom.files.wordpress.com/2023/01/cover.png)

The source code (https://github.com/maxdemarzi/memgraph_benchmark) and instructions for recreating this benchmark is on github.

Tagged graph, graph database, graph databases, memgraph, neo4j, nosql, software, technology

4 thoughts on “Bullshit Graph Database Performance Benchmarks”

Jörg Baach says:

January 11, 2023 at 2:51 AM

Thanks a lot for your writeup. If I may ask: how do you connect from gatling to neo4j/memgraphdb?

Reply

maxdemarzi says:

January 11, 2023 at 12:24 PM

Using the Neo4j http endpoint. Blog post updated with Gatling test file source code.

Reply

Jörg Baach says:

January 13, 2023 at 9:04 AM

Thanks a lot!

Jam says:

January 13, 2023 at 7:29 AM

Sweet breakdown thanks for taking the time here. My faith in publicized benchmarks has been pretty shaky lately so it’s nice to see I’m not alone.

Reply