Week#3 Monitoring MySQL's Buffer Hit Rate

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1. INTRODUCTION

In this lab experiment, we target to measure the hit/miss ration in MySQL while running the TPC-C benchmark. The experiment is conducted by changing the buffer pool size from the 10% of DB size to the 50% of the DB size.

2. METHODS

When the requested page is in buffer pool, it is marked as HIT and it operates in DRAM. Otherwise, it is marked as MISS and it operates DISK I/O. The formula of HIT ratio is as follows *"Number of hits / Number of page requests to buffer cache"*. Since the time cost of DRAM access vs DISK access is ~ 1000 times, hit ratio highly effects the performance of the benchmark.

To conduct how the Hit ratio increases from the start of the benchmark to the end of the benchmark, we conducted SQL query *"show engine innodb status;"* to fetch the hit ratio and also compared among the Buffer Pool Size (%). Also, Disk I/O can be monitored by *"iostats"* command, iterated every 100 seconds while benchmarking to log the Disk I/O of the hardware.

3. Performance Evaluation

3.1 Experimental Setup

[System Setup]

MySQL version 5.7.33

OS Ubuntu 20.04.1 LTS (GNU/Linux 4.19.104-microsoft-standard

CPU model name Intel(R) Core(TM) i5-8250U CPU @ 1.60GHz

cpu cores 4

Vendor: Msft

Product: Virtual Disk

Revision: 1.0

Compliance: SPC-3

User Capacity: 274,877,906,944 bytes [274 GB]

Logical block size: 512 bytes

Physical block size: 4096 bytes

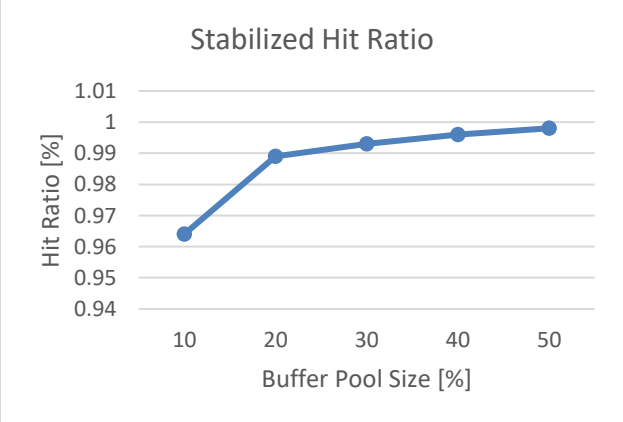
[Benchmark setup]

Type	Configuration
DB size	2GB (20 warehouse)
Buffer Pool	
Size	200MB (10% of DB size)
	400MB (20% of DB size)
	600MB (30% of DB size)
	800MB (40% of DB size)
	1000MB (50% of DB size)
Benchmark	
Tool	tpcc-mysql
Runtime	1200s
Connections	8

3.2 Experimental Results

[Hit Ratio among Buffer Pool Size]

Buffer Pool Size [%]	Start Hit Ratio [%]	End Hit Ratio [%]	Stabilized Hit Ratio [%]
10	0.958	0.964	0.964
20	0.978	0.988	0.989
30	0.983	0.994	0.993
40	0.986	0.996	0.996
50	0.989	0.998	0.998



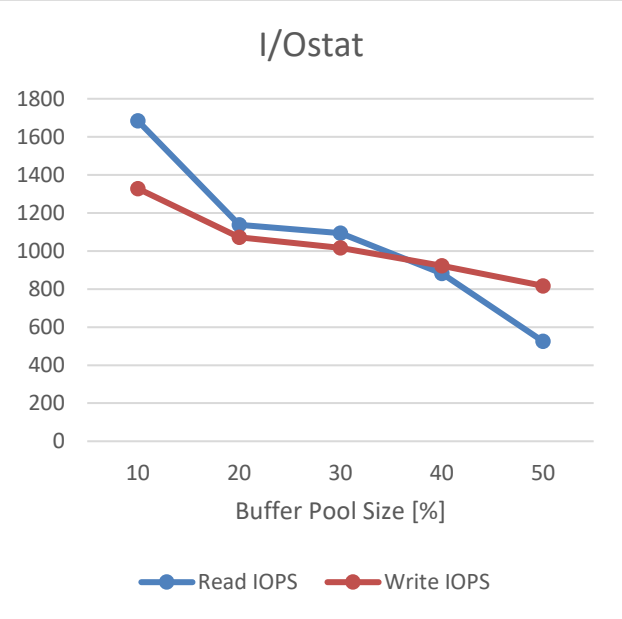
Since the Hit Ratio differs among Buffer Pool Size, logged the hit ratio by querying “show engine innodb status;” from the start of the benchmark until the end of the benchmark. The hit ratio increased along the benchmark, and it had a certain point when the hit ratio stabilized.

The increase in Hit Ratio at the same Buffer Pool size is because MySQL uses LRU (Least Recently Used) Algorithm for the Buffer Pool management. When using LRU, the page is all clean during the first few phases of iteration, but after few iterations some pages turn dirty, and it increases the probability of getting a Hit. Therefore, the Hit Ratio increases along side the Iteration in the same buffer pool size.

The increase in Hit Ratio along the increase of the Buffer Pool size is also related to MySQL using LRU. When there’s larger Pool, it means that after that large pool is filled with dirty pages, the probability of getting a Hit increase. Therefore, the hit ratio increases along the buffer pool size.

[IOSTAT among Buffer Pool Size]

Buffer Pool Size [%]	Read IO Per Second	Write IO Per Second
10	1684	1328
20	1137	1072
30	1094	1017
40	882	923
50	525	817



Disk I/O decreases over the increase of the Buffer Pool size. This is because when the hit ratio inreases, it means that the page is read from the DRAM which does not need reference to the Disk. Therefore, from the experiment looking into the correlation between the buffer pool size increases, the hit ratio increases, we can now find that the disk I/O decreases due to the increase of the hit ratio. Since there is no need to refer to the Disk since the page already exists in the DRAM.

4. Conclusion

When the Buffer Pool Size increases, the Hit Ratio increases, which means that there are more pages being founded inside the DRAM. Accordingly, the need to refer the Disk decreases, so the Disk I/O decreases when the Buffer Pool Size increases since the need to refer the Disk decreases because the page already exists in DRAM.

5. REFERENCES

[1] Plotting https://strongstrong.tistory.com/212

[2] Report format https://github.com/LeeBohyun/SWE3033-F2022/blob/main/report-guide.md

[3] Iostat Usage https://man7.org/linux/man-pages/man1/iostat.1.html