PostgreSQL Performance Tuning

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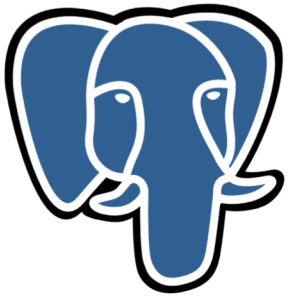
PostgreSQL

Why?

- One of the finest open source relational database which has some object-oriented features.
  Object-Relational database management system (RDBMS)
- PostgreSQL is free.
- PostgreSQL is Open Source.
- PostgreSQL Conform to the ANSI-SQL:2008.
- PostgreSQL is ACID (Atomicity, Consistency, Isolation and Durability) Complaint.



PostgreSQL

Who?

- Web technology
- Financial
- No-SQL Workload
- Small & Large Scale Business

Support?

There are many companies providing professional support for PostgreSQL.

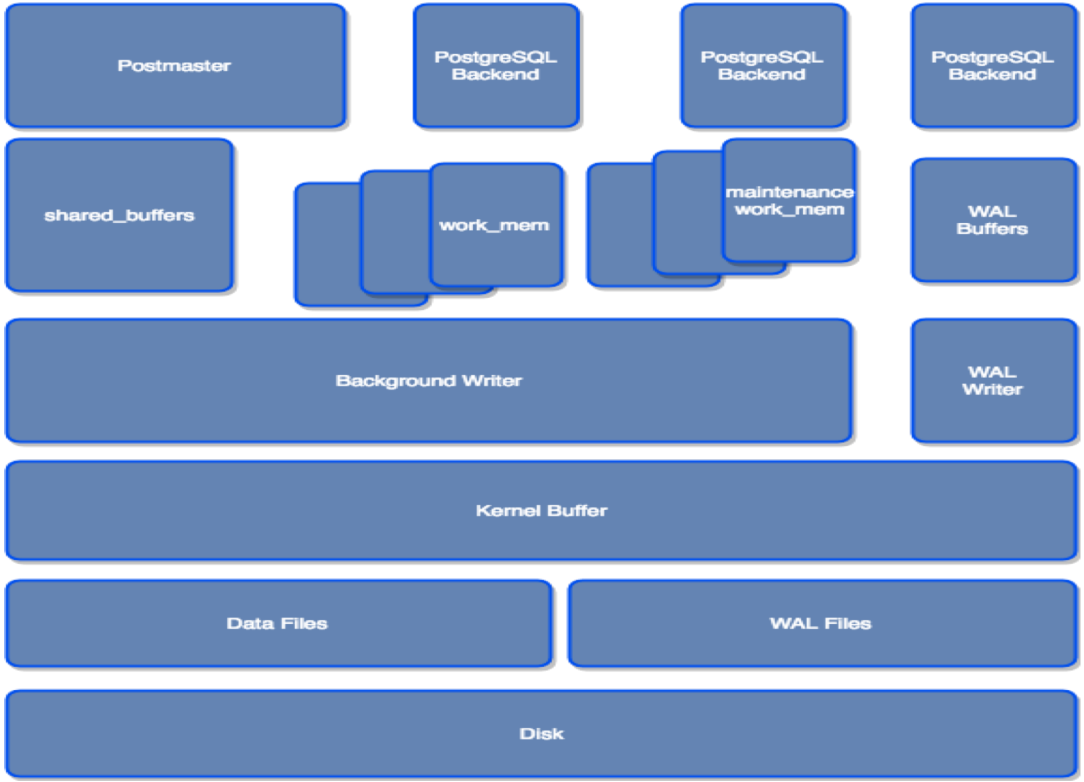
License?

PostgreSQL: Released under the PostgreSQL License. (Similar to the BSD or MIT)

Database Performance

- Hardware
- Operating System (Linux)
- Database (PostgreSQL) Configuration
- Workload
- Queries
- Application

PostgreSQL Tuning



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PostgreSQL Tuning - Configuration Parameter

- shared_buffer
- wal_buffers
- effective_cache_size
- work_mem
- maintenance_work_mem
- synchronous_commit
- checkpoint_timeout
- checkpoint_completion_target

PostgreSQL Tuning / shared_buffer

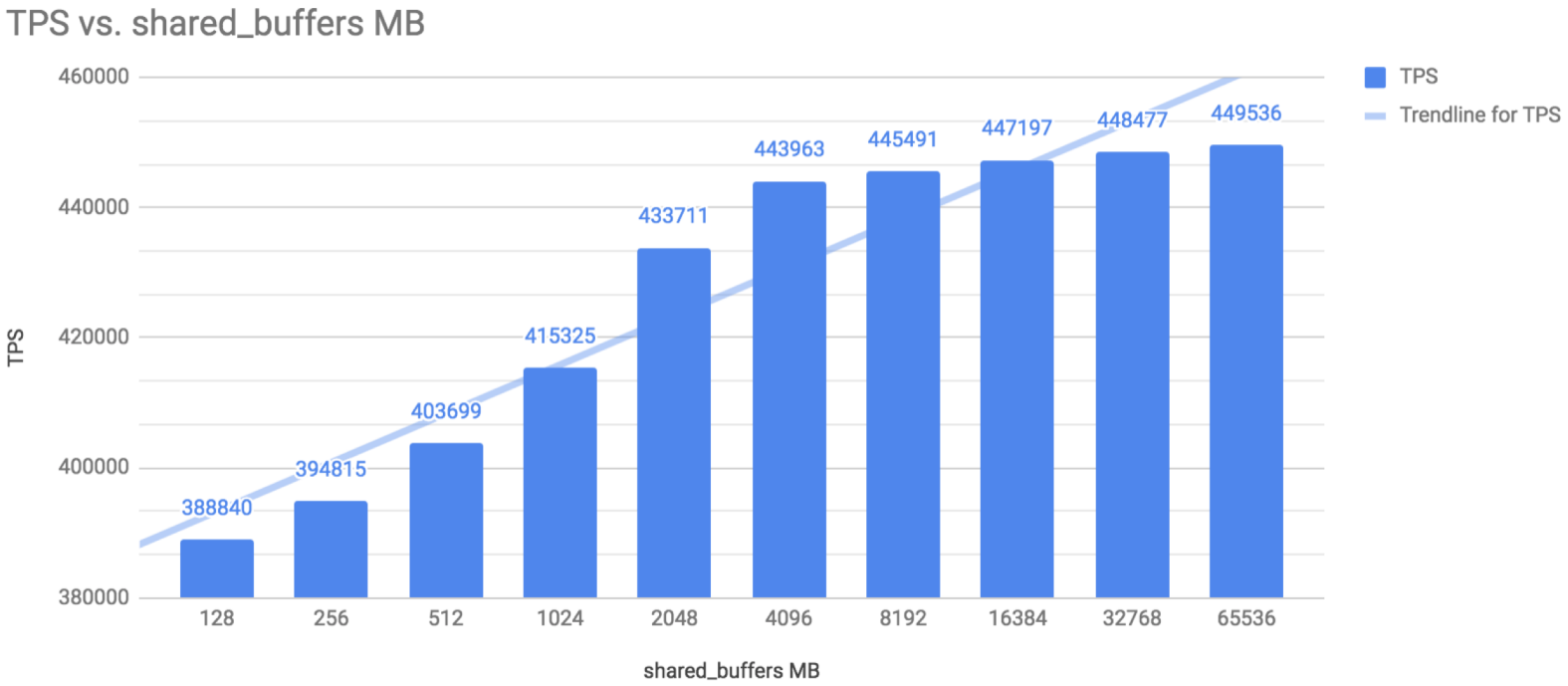
- PostgreSQL uses its own buffer and also uses kernel buffered I/O.
- PostgreSQL buffer is called shared_buffer.
- Data is written to shared_buffer then kernel buffer then on the disk.

```
postgresql=# SHOW shared_buffers;
shared_buffers
----------------
128MB
(1 row)
```

The proper size for the PostgreSQL shared buffer cache is the largest useful size that does not adversely affect other activity.

—Bruce Momjian

PostgreSQL Tuning / shared_buffer



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PostgreSQL Tuning / wal_buffer

- PostgreSQL writes its WAL (write ahead log) record into the buffers and then these buffers are flushed to disk.
- Bigger value for wal_buffer in case of lot of concurrent connection gives better performance.

PostgreSQL Tuning / effective_cache_size

- The effective_cache_size provides an estimate of the memory available for disk caching.
- It is just a guideline, not the exact allocated memory or cache size.
- It should be large enough to hold most accessed tables, but at the same time small enough to avoid swap.

PostgreSQL Tuning / work_mem

- This configuration is used for complex sorting.

work_mem = 2MB

```
testdb=# SET work_mem TO "2MB";
testdb=# EXPLAIN SELECT * FROM bar ORDER BY bar.b;
                                     QUERY PLAN
-------------------------------------------------------------------------------------
Gather Merge  (cost=509181.84..1706542.14 rows=10000116 width=24)
   Workers Planned: 4
   ->  Sort  (cost=508181.79..514431.86 rows=2500029 width=24)
         Sort Key: b
         ->  Parallel Seq Scan on bar  (cost=0.00..88695.29 rows=2500029 width=24)
(5 rows)
```

work_mem = 256MB

```
testdb=# SET work_mem TO "256MB";
testdb=# EXPLAIN SELECT * FROM bar ORDER BY bar.b;
                                     QUERY PLAN
-------------------------------------------------------------------------------------
Gather Merge  (cost=355367.34..1552727.64 rows=10000116 width=24)
   Workers Planned: 4
   ->  Sort  (cost=354367.29..360617.36 rows=2500029 width=24)
         Sort Key: b
         ->  Parallel Seq Scan on bar  (cost=0.00..88695.29 rows=2500029 width=24)
```


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PostgreSQL Tuning / maintenance_work_mem

- maintenance_work_mem is a memory setting used for maintenance tasks.
- The default value is 64MB.
- Setting a large value helps in tasks like VACUUM, RESTORE, CREATE INDEX, ADD FOREIGN KEY and ALTER TABLE.

maintenance_work_mem = 10MB

```
1  postgres=# CHECKPOINT;
2  postgres=# SET maintenance_work_mem to '10MB';
3
4  postgres=# CREATE INDEX foo_idx ON foo (c);
5  CREATE INDEX
6  Time: 170091.371 ms (02:50.091)
```

maintenance_work_mem = 256MB

```
1  postgres=# CHECKPOINT;
2  postgres=# set maintenance_work_mem to '256MB';
3
4  postgres=# CREATE INDEX foo_idx ON foo (c);
5  CREATE INDEX
6  Time: 111274.903 ms (01:51.275)
```

PostgreSQL Tuning / synchronous_commit

- This is used to enforce that commit will wait for WAL to be written on disk before returning a success status to the client.
- This is a trade-off between performance and reliability.
- Increasing reliability decreases performance and vice versa.

PostgreSQL Tuning / checkpoint_timeout

- PostgreSQL writes changes into WAL. The checkpoint process flushes the data into the data files.
- More checkpoints have a negative impact on performance.

Linux Tuning - Huge Pages

- Linux, by default uses 4K memory pages.
- Linux also has Huge Pages, Transparent huge pages.
- BSD has Super Pages.
- Windows has Large Pages.
- Linux default page size is 4K.
- Default Huge page size is 2MB.

Linux Tuning / vm.swappiness

- This is another kernel parameter that can affect the performance of the database.
- Used to control the swappiness (swapping pages to and from swap memory into RAM) behaviour on a Linux system.

Linux Tuning / vm.overcommit_memory and vm.overcommit_ratio

- Applications acquire memory and free that memory when it is no longer needed.
- But in some cases an application acquires too much memory and does not release it. This can invoke the OOM killer.
  - Heuristic overcommit, Do it intelligently (default); based kernel heuristics
  - Allow overcommit anyway
  - Don’t over commit beyond the overcommit ratio.

Linux Tuning / vm.dirty_background_ratio and vm.dirty_background_bytes

- The vm.dirty_background_ratio is the percentage of memory filled with dirty pages that need to be flushed to disk.
- Flushing is done in the background.
  The value of this parameter ranges from 0 to 100;

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Blogs

- Tuning PostgreSQL Database Parameters to Optimise Performance.
  - https://www.percona.com/blog/2018/08/31/tuning-postgresql-database-parameters-to-optimize-performance/
- Tune Linux Kernel Parameters For PostgreSQL Optimisation
  - https://www.percona.com/blog/2018/08/29/tune-linux-kernel-parameters-for-postgresql-optimization/

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