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Exploiting NVMe for high-performance logging in In-Memory OLTP Engine

Keywords: DBMS, Concurrent Programming, Data Structures, Indexes, Trie

Problem: DBMS employs logging for delaying data persistence in the storage, and in case of a failure, be able to recover to a consistent state; aborting/undo in-progress transaction while redo committed transaction on the previous data snapshot. Logging imposes significant overhead in critical path of transaction processing given the persistence requirement. There have been many proposals in logging literature, including group commits, delayed or async commits, time-delta guarantees, etc.

Project: In this project, the student will implement logging and recovery algorithms in an in-memory state-of-the-art OLTP engine, and then, through performance evaluation, analyze and alleviate the bottlenecks in the critical path of transactional processing, allowing OLTP engine to overcome the stalls of writes to persistent storage.

Plan:

1. Implement logging and recovery based on [1].
2. Analyze and alleviate performance bottlenecks of logging in critical path.
3. Partition loggers based on NUMA and available storage mediums.
4. Analyze the impact of logging on recovery performance, by switching data to command logging and vice versa.

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Duration: 6 months

References

[1] Haubenschild, Michael, Caetano Sauer, Thomas Neumann, and Viktor Leis. "Rethinking logging, checkpoints, and recovery for high-performance storage engines." In Proceedings of the 2020 ACM SIGMOD International Conference on Management of Data, pp. 877-892. 2020.

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