50.043 Database Lab 3 Report

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50.043 Database System and Big Data ~ Lab 3

Summary and Design decisions

Exercise 1, 2 & 5 ~ Lock acquisition and release in Bufferpool

Created a seperate Lockmanger class that manges lock state using a concurrentHashMap data structure. LockManager uses four main data structures;

1. PageLocks maps PageId to sets of lock objects
2. TransactionLocks maps TransactionId to sets of Locks held
3. WaitingQueue maintains FIFO queues of lock requests per page
4. WaitForGraph tracks transaction dependencies for deadlock detection

The implemented data structures provide efficient lookup and maintenance operations and ensures thread safety through synchronized blocks. The design checks if the lock can be granted immediately, otherwise it adds the transaction to the wait-for graph, performing cycle detection, and enqueues the request.

In bufferpool.java, GetPage() function was modified to acquire a lock from lock manager before returning pages to ensure all page access goes through proper lock acquisition and proper permissions checking. UnsafeReleasePage() was implemented to release both read and write lock. The two-phase locking protocol is implemented through shared and exclusive locks along with a deadlock detection mechanism.

Exercise 3 ~ NO STEAL Buffer management

The NO STEAL policy was implemented by modifying evictPage() to iterate through the bufferpool pages, only evicting clean pages. In the case that no clean pages are found, a DbException is thrown to prevent the eviction of dirty pages from uncommitted transactions. Uses first-found clean page selection for eviction.

Exercise 4 ~ Transaction Completion

TransactionComplete() was implemented with commit/abort logic; On commit, the function calls flushPages(tid) to write all transaction's dirty pages to disk. On abort, it restores pages to before-image state by replacing dirty pages in bufferpool. And always releases all transaction locks in finally block regardless of commit/abort outcome to guarantee lock cleanup, preventing deadlock from unreleased locks

Missing/Incomplete Elements Of Our Code/Changes Made To The API

All Lab 1, 2 and 3 code have been implemented. No Changes made to the API