Transactions & System R

6.033 Quiz 3 Review

Atomicity

- Recoverable Action – either completes OR aborts without effect
- Isolated Action – each action done in some order (A then B, or B then A)
- Atomic Action – recoverable and isolated

Desirable Properties

- Fail-fast on detected error
- Idempotence
- Bootstrapping

Composite Operations

- Version histories
  - Never erase anything
  - List of cells represent history of variable
  - Recoverable action ID
- Mark-point-sequential isolation
  - Mark each version intend to write
  - Reach mark point
  - Read and write values

Logs

- Stability Log
- Archive Log
- Recovery Log
- Write-Ahead Log (WAL) Protocol
  - Write what intend to do first in log
  - Then do it

Logs (continued)

- Backout-list Log
  - Log old value with new
  - Log ‘commit’ or ‘abort’
- Intentions-list Log
  - Log new value and commit record
  - Update persistent storage
  - Log completion note

Recovery Optimizations

- Add BEGIN record
- Checkpoint record contains uncommitted actions
- Timer expiration

System R

- Research Storage System (RSS) manages physical memory & trans
  - Provides recoverable actions
- BEGIN/COMMIT/ABORT abstractions
- Undo/redo info stored in log
- Current vs. shadow version of file
- Provides recoverable transactions

Locking protocol

- Needed for isolation and to correctly abort actions
- Simple locking
  - Acquire all locks, read/write, commit, release all locks
- 2-phase locking
  - Allow writes after acquire locks and don’t release until commit point
- Can keep lock info in volatile storage

Forced writes

- Needed for proper recovery
  - Force append to log before writing data
  - Force all data updates before commit/abort entry
  - Force commit record

Avoiding deadlock

- Timer expiration
- Lock ordering
- Cycle detection

Multi-site atomicity

- 2-phase commit
  - Coordinator requests sub-action at remote site
  - Response from remote site
  - Completion message from coordinator
- Timeout/resend inquiries if no response received