Database Management System – 38 Transaction Processing (System log, ACID properties, Commit point)

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Outline

- Transaction and system concepts
- System log
- Commit point of a transaction
- ACID Properties

Transaction and System Concepts

- A transaction is an atomic unit of work that should either be completed in its entirety or not done at all
- System must keep track of when each transaction starts, terminates, commits, and/or aborts
  - *BEGIN_TRANSACTION*
  - *READ or WRITE*
  - *END_TRANSACTION*
  - *COMMIT_TRANSACTION* - successful end of the transaction
  - *ROLLBACK (or ABORT)* - ended unsuccessfully

Transaction and System Concepts (cont'd.)
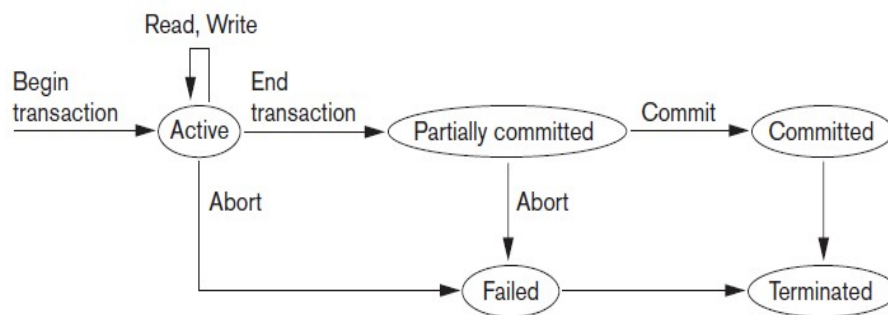
System Log

- System log keeps track of transaction operations
- Sequential, append-only file
- Not affected by failure (except disk or catastrophic failure)
- Log buffer
  - Main memory buffer
  - When full, appended to end of log file on disk
- Log file is backed up periodically
- Undo and redo operations based on log possible

System log

- *[start_transaction, T]*
  - Indicates that transaction T has started execution
- *[write_item, T, X, old_value, new_value]*
  - Indicates that transaction T has changed the value of database item *X* from *old_value* to *new_value*
- *[read_item, T, X]*
  - Indicates that transaction T has read the value of database item *X*
- *[commit, T]*
  - Indicates that transaction T has completed successfully, and affirms that its effect can be committed (recorded permanently) to the database
- *[abort, T]*
  - Indicates that transaction T has been aborted

Commit Point of a Transaction

- Occurs when all operations that access the database have completed successfully
  - and effect of operations recorded in the log
- Transaction writes a commit record into the log
  - If system failure occurs, can search for transactions with recorded *start_transaction* but no commit record
- Force-writing the log buffer to disk
  - Writing log buffer to disk before transaction reaches commit point

DBMS-Specific Buffer Replacement Policies

- Page replacement policy
  - Selects particular buffers to be replaced when all are full
- Domain separation (DS) method
  - Each domain handles one type of disk pages
    - Index pages
    - Data file pages
    - Log file pages
- Number of available buffers for each domain is predetermined

DBMS-Specific Buffer Replacement Policies (cont'd.)

- Hot set method
  - Useful in queries that scan a set of pages repeatedly
  - Does not replace the set in the buffers until processing is completed
- DBMIN method
  - Predetermines the pattern of page references for each algorithm for a particular type of database operation
  - Calculates locality set using query locality set model (QLSM)

Desirable Properties of Transactions

- ACID properties
  - Atomicity
    - Transaction performed in its entirety or not at all
  - Consistency preservation
    - Takes database from one consistent state to another
  - Isolation
    - Not interfered with by other transactions
  - Durability or permanency
    - Changes must persist in the database

Desirable Properties of Transactions (cont'd.)

- Levels of isolation
  - Level 0 isolation does not overwrite the dirty reads of higher-level transactions
  - Level 1 isolation has no lost updates
  - Level 2 isolation has no lost updates and no dirty reads
  - Level 3 (true) isolation
    - In addition to level 2 properties has repeatable reads

Reference

- Elmasri R. and S. Navathe, Database Systems: Models, Languages, Design and Application Programming, Pearson Education 6th edition and 7th edition

Thank you