Assignment 8 – Week 12

This assignment is based on lecture 10 (chapter 22 – Database Recovery).

o Submit your *own work* on time. No credit will be given if the assignment is submitted after the due date.
o Note that the completed assignment should be submitted in .doc, .docx, .rtf or .pdf format only.
o In MCQs, if you think that your answer needs more explanation to get credit then please write it down.
o You are encouraged to discuss these questions in the Sakai forum.

(1) What is meant by granularity? Give examples.
ANS: Granularity refers to the size of the data item that the database system locks or manages during transaction processing. High granularity means locking small data items, such as a single row or record, which allows for higher concurrency but increases system overhead. Low granularity means locking large data items, such as an entire table or the entire database, which reduces overhead but limits concurrency. For example, locking a single row in a table is high granularity, while locking the entire table is low granularity.

(2) Discuss the types of failure that may occur in a database environment. Explain why it is important for a multi-user DBMS to provide a recovery mechanism.
ANS: In a database environment, various types of errors can occur. Transaction errors occur due to logical errors, constraint violations, or deadlocks. System errors occur due to power failures or operating system crashes, where main memory is lost but data on disk remains intact. Media errors occur when storage devices such as disks are damaged or fail. Communication errors occur in distributed database systems due to network problems.
It is crucial that a multi-user database management system provides recovery mechanisms to ensure that the database remains consistent. Recovery mechanisms ensure atomicity, consistency, and durability by undoing incomplete transactions and preserving the results of completed transactions after an error occurs.

(3) Discuss how the log file (or journal) is a fundamental feature in any recovery mechanism. Explain what is meant by forward and backward recovery and describe how the log file is used in forward and backward recovery.
ANS: The log file is a fundamental feature of the database recovery process because it records all actions performed by transactions, including transaction start, data updates, commits, and rollbacks. The log file allows the database management system (DBMS) to determine which transactions were completed and which were not completed at the time of a failure.
Backward recovery is used to undo the effects of uncommitted transactions by scanning the log backward and restoring the old data values. Forward recovery is used to redo the effects of committed transactions by scanning the log forward and reapplying the updates. The log file makes both types of recovery possible.

(4) What is the significance of the write-ahead log protocol? How do checkpoints affect the recovery protocol?
ANS: The write-ahead logging protocol ensures that all log records describing database updates are written to stable storage before the actual database changes are written to disk. This guarantees that recovery information is always available in case of a failure.
Checkpoints improve the efficiency of the recovery process by saving the current state of the database and marking a position in the log. During recovery, the system only needs to process log records created after the last checkpoint, which significantly reduces recovery time.

(5) Compare and contrast the deferred update and immediate update recovery protocols.
ANS: In the deferred update recovery protocol, database updates are not applied until the transaction successfully completes. Therefore, only redo operations are needed during recovery. This approach is simpler but may reduce performance.
In the immediate update recovery protocol, updates are applied to the database as soon as they occur, even before the transaction completes. This requires both undo and redo operations during recovery. Immediate updates offer better performance but have a more complex recovery process.