Durability

A successful transaction contains this operation.

```
update customer set balance = balance + 100;
```

The above operation causes the following actions to take place.

a) Write data to database file
b) Read data from database file into database buffer
c) Write data to log buffer
d) Write data to the rollback segment
e) Write data to log file
f) Update data in data buffer

1. In which sequence will the above actions be executed? b → f → d → c → e → a
2. Why is data written to the log buffer and then to the log file asynchronously

Data is written to the log buffer first for speed, then asynchronously to the log file to reduce disk I/O and improve performance, ensuring durability before the transaction commits.

3. Assume a successful transaction is committed.

   After which point (from the actions above) will the DBMS have to honour the transaction even if a system or media failure occurs shortly afterwards.

The DBMS must honor the transaction after the data has been written to the log file. This ensures that the transaction can be recovered in case of a system or media failure.

4. What event ensures that the log buffer is flushed to the log file ?

   The log buffer is flushed to the log file when a transaction commits or when the log buffer becomes full.

5. Transaction A has performed the following operations:

   - Insert
   - Insert
   - Insert
   - Update

   Assume that each of the above operations has physically written to the log file. However, the transaction has not yet been completed.

   Which one of the following options best describes what has happened to the database file?

   a) Some of the operations above, will have caused changes to the database file
   b) None of the operations above, will have caused changes to the database file B
   c) All of the operations above, will have caused changes to the database file
   d) Any of the above is possible

6. What is a checkpoint? A checkpoint is a process in the database where all modified data in the buffer is written to the database file, and log entries are synchronized.

7. True or false?
   - All transactions must be completed before a checkpoint can take place F
   - A transaction can be partially completed when a checkpoint take place T

8. Consider the transaction log entries shown below. All transactions consist of inserts into tables named DEPOSIT, WITHDRAWAL and INTEREST rows into a database. Some transactions involve only one database operation. Some transactions others involve several operations.

   For each log entry, the transaction ID, the time, the action performed, the table and row ID affected and the row before/after images are recorded (details not shown). Log entries for checkpoints, transaction starts, commits and rollbacks are also recorded as shown. All transactions occurred in the given order.

Tran ID	Action	Table Affected	Rowid	Before	After
1	START				
2	START				
1	INSERT	DEPOSIT	300		---/---
1	INSERT	WITHDRAWL	200		---/---
2	INSERT	INTEREST	100		---/---
2	INSERT	INTEREST	101		---/---
1	COMMIT				
3	START				
3	INSERT	DEPOSIT	301		---/---
4	START				
4	INSERT	DEPOSIT	600		
	CHECKPOINT				
3	INSERT	WITHDRAWL	201		---/---
5	START				
2	INSERT	INTEREST	102		---/---
5	INSERT	DEPOSIT	302		---/---
3	ROLLBACK				
5	COMMIT				
2	INSERT	INTEREST	103		---/---
6	START				
2	COMMIT	INTEREST	104		---/---
6	INSERT	WITHDRAWL	202		---/---

end of log

9. What is a system failure?

A system failure refers to a situation where the DBMS crashes or the system goes down, causing the system to stop functioning unexpectedly. In this case, data that was not yet saved to the database file but was recorded in the log file might be at risk.

Assume that as system failure occurred after the final entry in the above log file was made. When a system failure occurs, the DBMS examines the log file.

10. Consider transaction 1.
    - Was it completed before the checkpoint? Yes
    - Were all of the logged actions of transaction 1 written to the database file? Yes
    - What should happen to this transaction Undo / Redo / No Action? No Action

11. Consider transaction 2.
    - Was it completed before the checkpoint? No
    - Were any of the actions of transaction 2 logged before the checkpoint written to the database file? Yes
    - Were any of the actions of transaction 2 logged after the checkpoint written to the database file? No
    - What should happen to this transaction Undo / Redo / No Action? Redo

12. Consider transaction 3.
    - Was it completed before the checkpoint? No
    - Were any of the actions of transaction 3 logged before the checkpoint written to the database file? Yes
    - Were any of the actions of transaction 3 logged after the checkpoint written to the database file prior to the system failure occurring. No
    - What should happen to this transaction Undo / Redo / No Action? Redo

13. Consider transaction 4.
    - Was it completed before the checkpoint? No
    - Were any of the actions of transaction 4 logged before the checkpoint written to the database file? Yes
    - What should happen to this transaction Undo / Redo / No Action? Undo

14. Consider transaction 5.
    - Was it started after the checkpoint? Yes
    - The log shows that this transaction was rolled-back
        - At the time of the systems failure, could any of the actions performed by this transaction been written to the database file? No
        - Were any of the actions of this transaction written to the database file? Yes
    - What should happen to this transaction Undo / Redo / No Action? Undo

15. Consider transaction 6.
    - What should happen to this transaction Undo / Redo / No Action? Undo

16. How does a **media failure** differ from a systems failure

A media failure occurs when the storage device (e.g., disk) is damaged or corrupted, causing data to be lost or inaccessible. Recovery typically involves restoring data from backups.A system failure, on the other hand, is when the system crashes due to software bugs, hardware malfunctions, or power loss, but the storage remains intact. Recovery involves using log files to redo or undo transactions after the system restarts.

17. Assume that a **media failure** has occurred. Yes
    It is necessary to revert to the **backup** that was done just prior to the start of this log.

18. How often should a checkpoint occur? base on business rule

19. What transactions need to be
    - Redone If transactions are not commited or rolledback after a checkpoint
    - Undone If transaction are rolledback or commited after a checkpint

20. List 3 distinct events that can cause the DBMS to fail. Specify what action could be taken by the recovery manager to repair the database. System Crash, Media failure, Software Failure

21. Describe the state transactions during a backup.
    Commited/Uncommiteed transaction are Completed but not writtent to dsik

Lab Tasks

Continue with Assignment work