

Chapter 6: Database Recovery Techniques

Question 6.1. Describe some non-catastrophic failures and catastrophic failures. Introduce some approaches to deal with these failures.

Question 6.2. State the purposes of database recovery from transaction failures.

Question 6.3. What are transaction commit points? Why are they important?

Question 6.4. What are checkpoints? Why are they important? What is fuzzy checkpointing?

Question 6.5. Distinguish deferred update with immediate update.

Question 6.6. What are the before image (BFIM) and after image (AFIM) of a data item? What is the difference between in-place updating and shadowing, with respect to their handling of BFIM and AFIM?

Question 6.7. Describe UNDO and REDO operations. Distinguish them from transaction rollback and roll-forward.

Question 6.8. Describe the write-ahead logging protocol.

Question 6.9. Describe the policies when a page from the database cache can be written to disk: steal/no-steal, force/no-force.

Question 6.10. Discuss the deferred update technique of recovery. What are the advantages and disadvantages of this technique? Why is it called the NO-UNDO/REDO method?

Question 6.11. Discuss the immediate update recovery technique in both single-user and multiuser environments. What are the advantages and disadvantages of immediate update? What is the difference between the UNDO/REDO and the UNDO/NO-REDO algorithms for recovery with immediate update?

Question 6.12. Describe the shadow paging recovery technique. Under what circumstances does it not require a log? Why is it called a NO-UNDO/NO-REDO method?

Question 6.13. Describe the three phases of the ARIES recovery method.

Question 6.14. Describe the two-phase commit protocol for multidatabase transactions.

Question 6.15. Discuss how disaster recovery from catastrophic failures is handled.

Question 6.16. Given a system log as follows. Suppose that:

- (1). the system crashes before the [read_item, T3, A] entry is written to the log
- (2). the system crashes before the [write_item, T2, D, 25, 26] entry is written to the log.

Describe the recovery process for each case.

	A	B	C	D
	30	15	40	20
[start_transaction, T_3]				
[read_item, T_3 , C]				
[write_item, T_3 , B, 15, 12]		12		
[start_transaction, T_2]				
[read_item, T_2 , B]				
[write_item, T_2 , B, 12, 18]		18		
[start_transaction, T_1]				
[read_item, T_1 , A]				
[read_item, T_1 , D]				
[write_item, T_1 , D, 20, 25]				25
[read_item, T_2 , D]				
[write_item, T_2 , D, 25, 26]				26
[read_item, T_3 , A]				

Question 6.17. Given the log corresponding to a particular schedule at the point of a system crash for four transactions T_1 , T_2 , T_3 , and T_4 .

Describe the recovery process from the system crash. Specify which transactions are rolled back, which operations in the log are redone and which (if any) are undone, and whether any cascading rollback takes place.

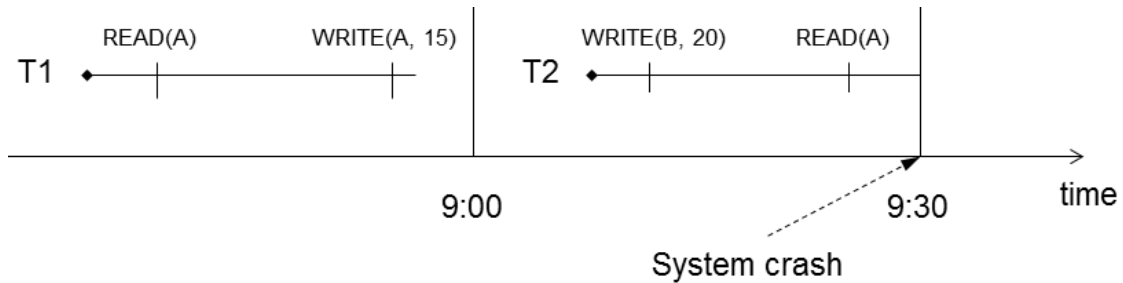
- (1). use the deferred update protocol with checkpointing
- (2). use the *immediate update protocol* with checkpointing

[start_transaction, T_1]
[read_item, T_1 , A]
[read_item, T_1 , D]
[write_item, T_1 , D, 20, 25]
[commit, T_1]
[checkpoint]
[start_transaction, T_2]
[read_item, T_2 , B]
[write_item, T_2 , B, 12, 18]
[start_transaction, T_4]
[read_item, T_4 , D]
[write_item, T_4 , D, 25, 15]
[start_transaction, T_3]
[write_item, T_3 , C, 30, 40]
[read_item, T_4 , A]
[write_item, T_4 , A, 30, 20]
[commit, T_4]
[read_item, T_2 , D]
[write_item, T_2 , D, 15, 25]

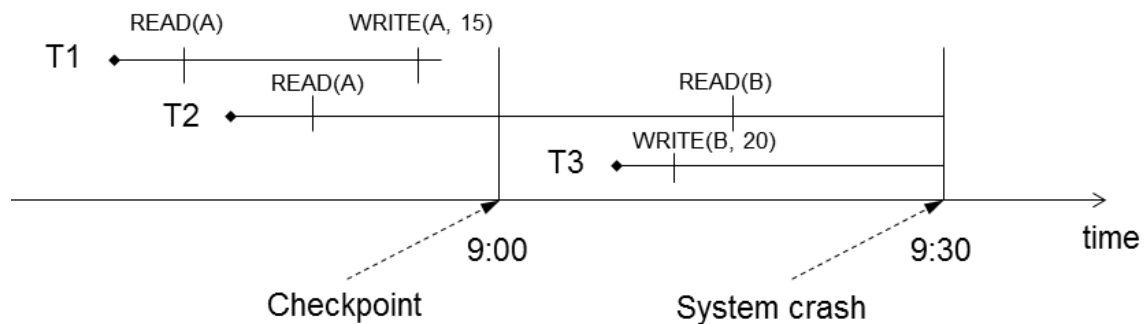
← System crash

Question 6.18. Given the execution of the transactions in (a), (b), and (c) as follows. For each execution, describe the recovery process after the system crashes using the deferred update protocol with checkpointing. Repeat the question with the immediate update protocol.

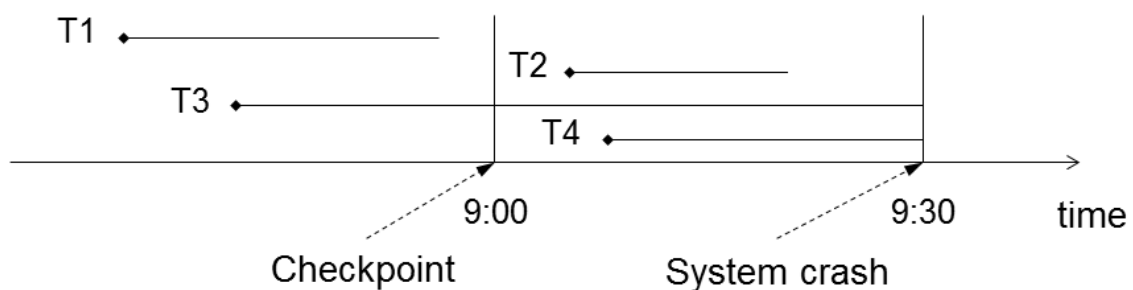
(a).



(b).



(c).



Question 6.19. Given the log when the system crashes, the Transaction and Dirty Page tables at the checkpoint as follows. Describe the recovery process using ARIES.

The log:

LSN	LAST_LSN	TRAN_ID	TYPE	PAGE_ID	...
1	0	T1	update	C	...
2	1	T1	update	B	...
3	0	T2	update	C	...
4	begin_checkpoint				
5	end_checkpoint				
6	2	T1	commit		...
7	0	T3	update	A	...

The Transaction Table and Dirty Page Table:

TRANSACTION TABLE			DIRTY PAGE TABLE	
TRANSACTION ID	LAST LSN	STATUS	PAGE ID	LSN
T1	2	in progress	C	1
T2	3	in progress	B	2

Question 6.20. Given the log when the system crashes as follows. Describe the recovery process using: (1). deferred update, (2). immediate update, and (3). ARIES methods.

LSN	LAST_LSN	TRAN_ID	TYPE	PAGE_ID	...
0	begin_checkpoint				
1	end_checkpoint				
2	0	T1	update	P5	...
3	0	T2	update	P3	...
4	3	T2	commit		
5	4	T2	end		
6	0	T3	update	P3	...
7	2	T1	update	P2	...