

LSN	LOG
00	update: T1 writes P2
10	update: T1 writes P1
20	update: T2 writes P5
30	update: T3 writes P3
40	T3 commit
50	update: T2 writes P5
60	update: T2 writes P3
70	T2 abort

Figure 1: A transaction log

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## 1: Recovery

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Consider the execution shown in Figure 1.

(a) Extend the figure to show prevLSN and undonextLSN values.

**Solution:** The extended figure is shown below:

LSN	prevLSN	undonextLSN(of a CLR corresponds to the log record)
00	-	-
10	00	00
20	-	-
30	-	-
40	30	- (not an update log record)
50	20	20
60	50	50
70	60	- (not an update log record)

(b) Describe the actions taken to rollback transaction T2.

**Solution:**

Step i) Restore P3 to the before-image stored in LSN 60.

Step ii) Restore P5 to the before-image stored in LSN 50.

Step iii) Restore P5 to the before-image stored in LSN 20.

(c) Show the log after T2 is rolled back, including all prevLSN and undonextLSN values in log records.

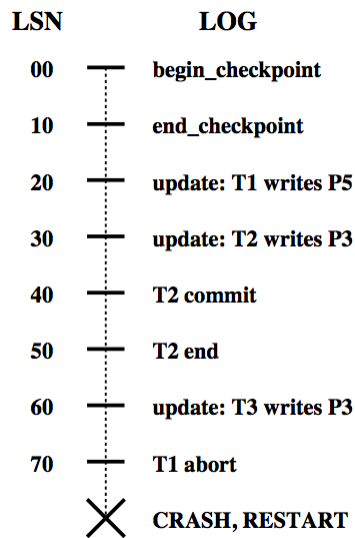


Figure 2: A transaction log

**Solution:**

The log tail should look something like this:

LSN	prevLSN	transID	type	pageID	undonextLSN
80	70	T2	CLR	P3	50
90	80	T2	CLR	P5	20
100	90	T2	CLR	P5	-
110	100	T2	END	-	-

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**2: Recovery**

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Consider the execution shown in Figure 2.

1. What is done during Analysis? (Be precise about the points at which Analysis begins and ends and describe the contents of any tables constructed in this phase.)

**Solution:**

For this example, we will assume that the Dirty Page Table and Transaction Table were empty before the start of the log. Analysis determines that the last begin checkpoint was at LSN 00 and starts at the corresponding end checkpoint (LSN 10). We will denote Transaction Table records as (transID, lastLSN) and Dirty Page Table records as (pageID, recLSN) sets. Then Analysis phase runs until LSN 70, and does the following:

The final Transaction Table has two entries: (T1, 70), and (T3, 60). The final Dirty Page Table has two entries: (P5, 20), and (P3, 30).

2. What is done during Redo? (Be precise about the points at which Redo begins and ends.)

**Solution:**

Redo starts at LSN 20 (smallest recLSN in DPT).

LSN	action
20	Adds (T1, 20) to TT and (P5, 20) to DPT
30	Adds (T2, 30) to TT and (P3, 30) to DPT
40	Changes status of T2 to C from U
50	Deletes entry for T2 from Transaction Table
60	Adds (T3, 60) to TT. Does not change P3 entry in DPT
70	Changes (T1, 20) to (T1, 70)

LSN	action
20	Changes to P5 are redone.
30	P3 is retrieved and its pageLSN is checked. If the page had been written to disk before the crash (pageLSN $\geq$ 30), nothing is re-done otherwise the changes are re-done.
40,50	No action
60	Changes to P3 are redone
70	No action

3. What is done during Undo? (Be precise about the points at which Undo begins and ends.)

**Solution:**

Undo starts at LSN 70 (highest lastLSN in TT). The Loser Set consists of LSNs 70 and 60. LSN 70: Adds LSN 20 to the Loser Set. Loser Set = (60, 20). LSN 60: Undoes the change on P3 and adds a CLR indicating this Undo. Loser Set = (20). LSN 20: Undoes the change on P5 and adds a CLR indicating this Undo.