3 Aries

a) Dirty Page Table:

PageID	recLSN
P_A	0

Transaction Table:

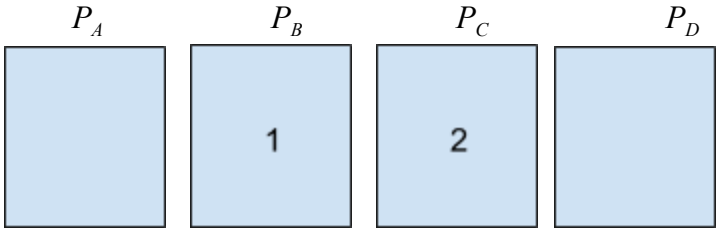
transID	status	lastLSN
T_1	running	0
T_2	running	1
T_3	running	2

Log:

LSN	transID	type	pageID	undoNextLSN	prevLSN
0	T_1	update	P_A		$\perp$
1	T_2	update	P_B		$\perp$
2	T_3	update	P_C		$\perp$

Where recLSN ~ lastLSN ~ LSN

pageLSN on disk:



b) Dirty Page Table:

PageID	recLSN
P_C	8
P_B	10

P_A	0

Transaction Table:

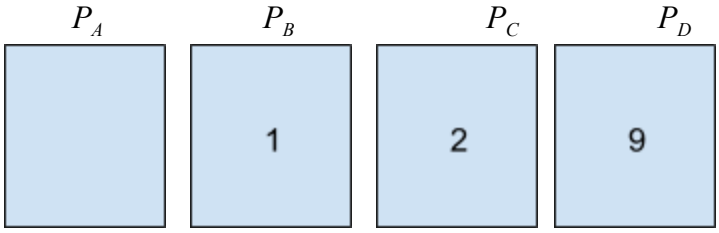
transID	status	lastLSN
T_2	running	10
T_3	running	11

Log:

LSN	transID	type	pageID	undoNextLSN	prevLSN
0	T_1	update	P_A		$\perp$
1	T_2	update	P_B		$\perp$
2	T_3	update	P_C		$\perp$
3	begin checkpoint				
3	end checkpoint				
4	T_2	update	P_D		1
5	T_1	update	P_A		0
6	T_1	commit	-		5
7	T_1	end	-		6
8	T_3	update	P_C		2
9	T_2	update	P_D		4
10	T_2	update	P_B		9
11	T_3	update	P_A		8

Where recLSN ~ lastLSN ~ LSN

pageLSN on disk of each page:



c) All log records prior and including the final force-write W2(D) are written to stable storage (LSN 0-9).

d) Dirty Page Table:

PageID	recLSN
P_A	0
P_C	8
P_D	4

Transaction Table:

transID	status	lastLSN
T_2	aborted	9
T_3	aborted	8

Log:

LSN	transID	type	pageID	undoNextLSN	prevLSN
0	T_1	update	P_A		$\perp$
1	T_2	update	P_B		$\perp$
2	T_3	update	P_C		$\perp$
3	begin checkpoint				
3	end checkpoint				
4	T_2	update	P_D		1
5	T_1	update	P_A		0

6	T_1	commit	-		5
7	T_1	end	-		6
8	T_3	update	P_C		2
9	T_2	update	P_D		4

Where recLSN ~ lastLSN ~ LSN

e) LSN 0 → Redone
LSN 1 → Does not need be redone because affected page is not in the dirty page table
LSN 2 → Does not need to be redone because for P_C, recLSN = 8 > LSN = 2
LSN 4 → Does not need to be redone because for P_D, pageLSN = 9 ≥ LSN = 4
LSN 5 → Redone
LSN 8 → Redone
LSN 9 → Does not need to be redone because for P_D, pageLSN = 9 ≥ LSN = 9

f) System must undo T_2 and T_3 …

Dirty Page Table:

PageID	recLSN
P_A	11
P_B	10
P_C	8
P_D	9

Transaction Table:

transID	status	lastLSN

Log:

LSN	transID	type	pageID	undoNextLSN	prevLSN
0	T_1	update	P_A		⊥

1	T_2	update	P_B		$\perp$
2	T_3	update	P_C		$\perp$
3	begin checkpoint				
3	end checkpoint				
4	T_2	update	P_D		1
5	T_1	update	P_A		0
6	T_1	commit	-		5
7	T_1	end	-		6
8	T_3	update	P_C		2
9	T_2	update	P_D		4
10	T_2	CLR	Undo T_2 LSN 9	4	9
11	T_3	CLR	Undo T_3 LSN 8	2	8
12	T_2	CLR	Undo T_2 LSN 4	1	10
13	T_3	CLR	Undo T_3 LSN 2	$\perp$	11
14	T_3	end	-		13
15	T_2	CLR	Undo T_2 LSN 1	$\perp$	12
16	T_2	end	-		15