

A.Y. 2020-2021  
Class: SE-ITA/B, Semester: III  
**Subject: Structured Query Lab**

Experiment – 10B): Implementation /Simulation of ARIES recovery Algorithm

**1. Aim:** To Implement Aries recovery technique

**2. Objective:**

- After performing the experiment, the students will be able to use log based recovery technique

**3. Outcome:** L303.6: To Demonstrate the concept of transaction, concurrency and recovery.

**4. Prerequisite:** Understanding of log based recovery

**5. Requirements:** PC, Oracle 11g/SQL Server 2008 R2, Microsoft Word, Internet, MySQL, JDK Netbeans,

**6. Pre-Experiment Exercise:**

**Brief Theory :**

What is Recovery?

Log Based Recovery

**7. Laboratory Exercise**

**A. Procedure:**

**Apply Aries recovery technique for following input file**

- W\_1(A, one)
- W\_2(B, two)
- Flush(B)
- W\_3(C, three)
- Flush(C)
- Checkpoint()
- W\_2(D, four)
- W\_1(A, five)
- Commit\_1()
- W\_3(C, six)
- W\_2(D, seven)
- Flush(D)
- W\_2(B, eight)
- W\_3(A, nine)

**B. Result/Observation/Program code:** Perform proper simulations and attach output of each phase.

**ARIES Simulator**

**About ⓘ**

**Operations**

- W\_1(A, one)
- > W\_2(B, two)
- Flush(B)
- W\_3(C, three)

Controls: ⏪ ⏩ (or left and right arrow keys)

**Explanation**

Current phase: **normal**

Transaction 1 wrote 'one' to page A.  
Page A was fetched from disk and brought into the buffer pool.  
The value of page A was updated from '1' to 'one' in the buffer pool, and the pageLSN was updated to 0.  
Page A was brought into the dirty page table with recLSN 0.

**Log**

LSN of last log record flushed to disk:

LSN	Trans ID	Type	Page ID	prevLSN
0	1	update	A	

**Dirty Page Table**

Page ID	recLSN
A	0

**Transaction Table**

Trans ID	Status	lastLSN
1	in progress	0

**Buffer Pool**

Page ID	pageLSN	Value
A	0	one

**Disk**

Page ID	pageLSN	Value
A	-1	1
B	-1	1
C	-1	1
D	-1	1

**ARIES Simulator**

**About ⓘ**

**Operations**

- W\_1(A, one)
- W\_2(B, two)
- > Flush(B)
- W\_3(C, three)

Controls: ⏪ ⏩ (or left and right arrow keys)

**Explanation**

Current phase: **normal**

Transaction 2 wrote 'two' to page B.  
Page B was fetched from disk and brought into the buffer pool.  
The value of page B was updated from '1' to 'two' in the buffer pool, and the pageLSN was updated to 1.  
Page B was brought into the dirty page table with recLSN 1.

**Log**

LSN of last log record flushed to disk:

LSN	Trans ID	Type	Page ID	prevLSN
0	1	update	A	
1	2	update	B	

**Dirty Page Table**

Page ID	recLSN
A	0
B	1

**Transaction Table**

Trans ID	Status	lastLSN
1	in progress	0
2	in progress	1

**Buffer Pool**

Page ID	pageLSN	Value
A	0	one
B	1	two

**Disk**

Page ID	pageLSN	Value
A	-1	1
B	-1	1
C	-1	1
D	-1	1

**ARIES Simulator**

**About**

**Operations**

- W\_2(B, two)
- Flush(B)
- > W\_3(C, three)
- Flush(C)

Controls: (or left and right arrow keys)

**Explanation**

Current phase: **normal**

Page B was flushed.

The pageLSN of page B is 1. That is, log entry 1 was the most recent log entry to modify page B. To ensure recoverability, we must ensure that every log entry up to and including entry 1 is flushed.

Finally, we flush page B from the buffer pool to disk, and remove the corresponding entries in the dirty page table and buffer pool.

**Log**

LSN of last log record flushed to disk: 1

LSN	Trans ID	Type	Page ID	prevLSN
0	1	update	A	
1	2	update	B	

**Dirty Page Table**

Page ID	recLSN
A	0

**Transaction Table**

Trans ID	Status	lastLSN
1	in progress	0
2	in progress	1

**Buffer Pool**

Page ID	pageLSN	Value
A	0	one

**Disk**

Page ID	pageLSN	Value
A	-1	⊥
B	1	two
C	-1	⊥
D	-1	⊥

**ARIES Simulator**

**About**

**Operations**

- Flush(B)
- W\_3(C, three)
- > Flush(C)
- Checkpoint()

Controls: (or left and right arrow keys)

**Explanation**

Current phase: **normal**

Transaction 3 wrote 'three' to page C.

Page C was fetched from disk and brought into the buffer pool.

The value of page C was updated from '1' to 'three' in the buffer pool, and the pageLSN was updated to 2.

Page C was brought into the dirty page table with recLSN 2.

**Log**

LSN of last log record flushed to disk: 1

LSN	Trans ID	Type	Page ID	prevLSN
0	1	update	A	
1	2	update	B	
2	3	update	C	

**Dirty Page Table**

Page ID	recLSN
A	0
C	2

**Transaction Table**

Trans ID	Status	lastLSN
1	in progress	0
2	in progress	1
3	in progress	2

**Buffer Pool**

Page ID	pageLSN	Value
A	0	one
C	2	three

**Disk**

Page ID	pageLSN	Value
A	-1	⊥
B	1	two
C	-1	⊥

**ARIES Simulator**

**About**

**Operations**

- W\_3(C, three)
- Flush(C)
- > Checkpoint()
- W\_2(D, four)

Controls: (or left and right arrow keys)

**Explanation**

Current phase: **normal**

Page C was flushed.

The pageLSN of page C is 2. That is, log entry 2 was the most recent log entry to modify page C. To ensure recoverability, we must ensure that every log entry up to and including entry 2 is flushed.

Finally, we flush page C from the buffer pool to disk, and remove the corresponding entries in the dirty page table and buffer pool.

**Log**

LSN of last log record flushed to disk: 2

LSN	Trans ID	Type	Page ID	prevLSN
0	1	update	A	
1	2	update	B	
2	3	update	C	

**Dirty Page Table**

Page ID	recLSN
A	0

**Transaction Table**

Trans ID	Status	lastLSN
1	in progress	0
2	in progress	1
3	in progress	2

**Buffer Pool**

Page ID	pageLSN	Value
A	0	one

**Disk**

Page ID	pageLSN	Value
A	-1	⊥
B	1	two
C	2	three
D	-1	⊥

**ARIES Simulator**

**About ⓘ**

**Operations ↻**

- Flush(C)
- Checkpoint()
- >W\_2(D, four)
- W\_1(A, five)

Controls: ⏪ ⏩ (or left and right arrow keys)

**Explanation**

Current phase: normal

ARIES checkpointed.  
A copy of the dirty page table and transaction table are stored in the checkpoint log entry.

**Log**

LSN of last log record flushed to disk: 2

LSN	Trans ID	Type	Page ID	prevLSN
0	1	update	A	
1	2	update	B	
2	3	update	C	
3		checkpoint		

**Dirty Page Table**

Page ID	recLSN
A	0

**Transaction Table**

Trans ID	Status	lastLSN
1	in progress	0
2	in progress	1
3	in progress	2

**Buffer Pool**

Page ID	pageLSN	Value
A	0	one

**Disk**

Page ID	pageLSN	Value
A	-1	⊥
B	1	two
C	2	three
D	-1	⊥

**ARIES Simulator**

**About ⓘ**

**Operations ↻**

- Checkpoint()
- W\_2(D, four)
- >W\_1(A, five)
- Commit\_1()

Controls: ⏪ ⏩ (or left and right arrow keys)

**Explanation**

Current phase: normal

Transaction 2 wrote 'four' to page D.  
Page D was fetched from disk and brought into the buffer pool.  
The value of page D was updated from '⊥' to 'four' in the buffer pool, and the pageLSN was updated to 4.  
Page D was brought into the dirty page table with recLSN 4.

**Log**

LSN of last log record flushed to disk: 2

LSN	Trans ID	Type	Page ID	prevLSN
0	1	update	A	
1	2	update	B	
2	3	update	C	
3		checkpoint		
4	2	update	D	1

**Dirty Page Table**

Page ID	recLSN
A	0
D	4

**Transaction Table**

Trans ID	Status	lastLSN
1	in progress	0
2	in progress	4
3	in progress	2

**Buffer Pool**

Page ID	pageLSN	Value
A	0	one
D	4	four

**Disk**

Page ID	pageLSN	Value
A	-1	⊥
B	1	two
C	2	three

**ARIES Simulator**

**About ⓘ**

**Operations ↻**

- W\_2(D, four)
- W\_1(A, five)
- >Commit\_1()
- W\_3(C, six)

Controls: ⏪ ⏩ (or left and right arrow keys)

**Explanation**

Current phase: normal

Transaction 1 wrote 'five' to page A.  
The value of page A was updated from 'one' to 'five' in the buffer pool, and the pageLSN was updated to 5.  
Page A was already in the dirty page table.  
Transaction 1 was already in the transaction table.  
Finally, an update log entry is appended to the log; all write operations generate update log entries.

**Log**

LSN of last log record flushed to disk: 2

LSN	Trans ID	Type	Page ID	prevLSN
0	1	update	A	
1	2	update	B	
2	3	update	C	
3		checkpoint		
4	2	update	D	1
5	1	update	A	0

**Dirty Page Table**

Page ID	recLSN
A	0
D	4

**Transaction Table**

Trans ID	Status	lastLSN
1	in progress	5
2	in progress	4
3	in progress	2

**Buffer Pool**

Page ID	pageLSN	Value
A	5	five
D	4	four

**Disk**

Page ID	pageLSN	Value
A	-1	⊥
B	1	two
C	2	three

**ARIES Simulator**      [About ⓘ](#)

**Operations**

- W\_1(A, five)
- Commit\_1()
- >W\_3(C, six)
- W\_2(D, seven)

Controls: (or left and right arrow keys)

**Explanation**  
Current phase: **normal**

Transaction 1 committed.

First, we append a commit and end log record to the log. Then, we flush the log and remove transaction 1 from the transaction table. The moment the commit log entry is persisted is when the transaction is considered committed.

**Log**  
LSN of last log record flushed to disk: 7

LSN	Trans ID	Type	Page ID	prevLSN
0	1	update	A	
1	2	update	B	
2	3	update	C	
3		checkpoint		
4	2	update	D	1
5	1	update	A	0
6	1	commit		5
7	1	end		6

**Dirty Page Table**

Page ID	recLSN
A	0
D	4

**Transaction Table**

Trans ID	Status	lastLSN
2	in progress	4
3	in progress	2

**Buffer Pool**

Page ID	pageLSN	Value
A	5	five
D	4	four

**Disk**

Page ID	pageLSN	Value
A	-1	1
B	1	two
C	2	three
D	-1	1

**ARIES Simulator**      [About ⓘ](#)

**Operations**

- Commit\_1()
- W\_3(C, six)
- >W\_2(D, seven)
- Flush(D)

Controls: (or left and right arrow keys)

**Explanation**  
Current phase: **normal**

Transaction 3 wrote 'six' to page C.

Page C was fetched from disk and brought into the buffer pool.

The value of page C was updated from 'three' to 'six' in the buffer pool, and the pageLSN was updated to 8.

Page C was brought into the dirty page table with recLSN 8.

**Log**  
LSN of last log record flushed to disk: 7

LSN	Trans ID	Type	Page ID	prevLSN
0	1	update	A	
1	2	update	B	
2	3	update	C	
3		checkpoint		
4	2	update	D	1
5	1	update	A	0
6	1	commit		5
7	1	end		6
8	3	update	C	2

**Dirty Page Table**

Page ID	recLSN
A	0
D	4
C	8

**Transaction Table**

Trans ID	Status	lastLSN
2	in progress	4
3	in progress	8

**Buffer Pool**

Page ID	pageLSN	Value
A	5	five
D	4	four
C	8	six

**Disk**

Page ID	pageLSN	Value
A	-1	1
B	1	two

**ARIES Simulator**      [About ⓘ](#)

**Operations**

- W\_3(C, six)
- W\_2(D, seven)
- >Flush(D)
- W\_2(B, eight)

Controls: (or left and right arrow keys)

**Explanation**  
Current phase: **normal**

Transaction 2 wrote 'seven' to page D.

The value of page D was updated from 'four' to 'seven' in the buffer pool, and the pageLSN was updated to 9.

Page D was already in the dirty page table.

Transaction 2 was already in the transaction table.

Finally, an update log entry is appended to the log; all write operations generate update log entries.

**Log**  
LSN of last log record flushed to disk: 7

LSN	Trans ID	Type	Page ID	prevLSN
0	1	update	A	
1	2	update	B	
2	3	update	C	
3		checkpoint		
4	2	update	D	1
5	1	update	A	0
6	1	commit		5
7	1	end		6
8	3	update	C	2
9	2	update	D	4

**Dirty Page Table**

Page ID	recLSN
A	0
D	4
C	8

**Transaction Table**

Trans ID	Status	lastLSN
2	in progress	9
3	in progress	8

**Buffer Pool**

Page ID	pageLSN	Value
A	5	five
D	9	seven
C	8	six

**Disk**

Page ID	pageLSN	Value
A	-1	1
B	1	two

**ARIES Simulator**

**About ⓘ**

**Operations** ↴

- W\_2(D, seven)
- Flush(D)
- > W\_2(B, eight)
- W\_3(A, nine)

Controls: ⏪ ⏩ (or left and right arrow keys)

**Explanation**

Current phase: normal

Page D was flushed.

The pageLSN of page D is 9. That is, log entry 9 was the most recent log entry to modify page D. To ensure recoverability, we must ensure that every log entry up to and including entry 9 is flushed.

Finally, we flush page D from the buffer pool to disk, and remove the corresponding entries in the dirty page table and buffer pool.

**Log**

LSN of last log record flushed to disk: 9

LSN	Trans ID	Type	Page ID	prevLSN
0	1	update	A	
1	2	update	B	
2	3	update	C	
3		checkpoint		
4	2	update	D	1
5	1	update	A	0
6	1	commit		5
7	1	end		6
8	3	update	C	2
9	2	update	D	4

**Dirty Page Table**

Page ID	recLSN
A	0
C	8

**Transaction Table**

Trans ID	Status	lastLSN
2	in progress	9
3	in progress	8

**Buffer Pool**

Page ID	pageLSN	Value
A	5	five
C	8	six

**Disk**

Page ID	pageLSN	Value
A	-1	one
B	1	two
C	2	three
D	9	seven

**ARIES Simulator**

**About ⓘ**

**Operations** ↴

- W\_2(D, seven)
- Flush(D)
- > W\_2(B, eight)
- W\_3(A, nine)

Controls: ⏪ ⏩ (or left and right arrow keys)

**Explanation**

Current phase: normal

Transaction 2 wrote 'eight' to page B.

Page B was fetched from disk and brought into the buffer pool.

The value of page B was updated from 'two' to 'eight' in the buffer pool, and the pageLSN was updated to 10.

Page B was brought into the dirty page table with recLSN 10.

**Log**

LSN of last log record flushed to disk: 9

LSN	Trans ID	Type	Page ID	prevLSN
0	1	update	A	
1	2	update	B	
2	3	update	C	
3		checkpoint		
4	2	update	D	1
5	1	update	A	0
6	1	commit		5
7	1	end		6
8	3	update	C	2
9	2	update	D	4
10	2	update	B	9

**Dirty Page Table**

Page ID	recLSN
A	0
C	8
B	10

**Transaction Table**

Trans ID	Status	lastLSN
2	in progress	10
3	in progress	8

**Buffer Pool**

Page ID	pageLSN	Value
A	5	five
C	8	six
B	10	eight

**Disk**

Page ID	pageLSN	Value
A	-1	one
B	1	two

**ARIES Simulator**

**About ⓘ**

**Operations** ↴

- W\_2(D, seven)
- Flush(D)
- > W\_2(B, eight)
- W\_3(A, nine)

Controls: ⏪ ⏩ (or left and right arrow keys)

**Explanation**

Current phase: normal

Transaction 3 wrote 'nine' to page A.

The value of page A was updated from 'five' to 'nine' in the buffer pool, and the pageLSN was updated to 11.

Page A was already in the dirty page table.

Transaction 3 was already in the transaction table.

Finally, an update log entry is appended to the log; all write operations generate update log entries.

**Log**

LSN of last log record flushed to disk: 9

LSN	Trans ID	Type	Page ID	prevLSN
0	1	update	A	
1	2	update	B	
2	3	update	C	
3		checkpoint		
4	2	update	D	1
5	1	update	A	0
6	1	commit		5
7	1	end		6
8	3	update	C	2
9	2	update	D	4
10	2	update	B	9
11	3	update	A	8

**Dirty Page Table**

Page ID	recLSN
A	0
C	8
B	10

**Transaction Table**

Trans ID	Status	lastLSN
2	in progress	10
3	in progress	11

**Buffer Pool**

Page ID	pageLSN	Value
A	11	nine
C	8	six
B	10	eight

**Disk**

Page ID	pageLSN	Value
A	-1	one
B	1	two

**ARIES Simulator**

**About ⓘ**

**Operations** ↕

- W\_2(D, seven)
- Flush(D)
- W\_2(B, eight)
- W\_3(A, nine)

Controls: ⏪ ⏩ (or left and right arrow keys)

**Explanation**

Current phase: **crashed**

ARIES crashed! The in-memory data structures (i.e. the dirty page table, the transaction table, the buffer pool, and the unflushed tail of the log) are all cleared. The only thing that remains is the flushed head of the log and the disk.

**Log**

LSN of last log record flushed to disk: 9

LSN	Trans ID	Type	Page ID	prevLSN
0	1	update	A	
1	2	update	B	
2	3	update	C	
3		checkpoint		
4	2	update	D	1
5	1	update	A	0
6	1	commit		5
7	1	end		6
8	3	update	C	2
9	2	update	D	4

**Dirty Page Table**

Page ID	recLSN

**Transaction Table**

Trans ID	Status	lastLSN

**Buffer Pool**

Page ID	pageLSN	Value

**Disk**

Page ID	pageLSN	Value
A	-1	1
B	1	two
C	2	three
D	9	seven

**ARIES Simulator**

**About ⓘ**

**Operations** ↕

- W\_2(D, seven)
- Flush(D)
- W\_2(B, eight)
- W\_3(A, nine)

Controls: ⏪ ⏩ (or left and right arrow keys)

**Explanation**

Current phase: **analysis**

ARIES began its analysis phase at LSN 3: the LSN of the most recent checkpoint.

The dirty page table and transaction table are loaded from the checkpoint.

**Log**

LSN of last log record flushed to disk: 9

LSN	Trans ID	Type	Page ID	prevLSN
0	1	update	A	
1	2	update	B	
2	3	update	C	
3		checkpoint		
4	2	update	D	1
5	1	update	A	0
6	1	commit		5
7	1	end		6
8	3	update	C	2
9	2	update	D	4

**Dirty Page Table**

Page ID	recLSN
A	0

**Transaction Table**

Trans ID	Status	lastLSN
1	in progress	0
2	in progress	1
3	in progress	2

**Buffer Pool**

Page ID	pageLSN	Value

**Disk**

Page ID	pageLSN	Value
A	-1	1
B	1	two
C	2	three
D	9	seven

**ARIES Simulator**

**About ⓘ**

**Operations** ↕

- W\_2(D, seven)
- Flush(D)
- W\_2(B, eight)
- W\_3(A, nine)

Controls: ⏪ ⏩ (or left and right arrow keys)

**Explanation**

Current phase: **analysis**

Transaction 2 updated page D.  
Page D was brought into the dirty page table with recLSN 4.  
Transaction 2 was already in the transaction table.

**Log**

LSN of last log record flushed to disk: 9

LSN	Trans ID	Type	Page ID	prevLSN
0	1	update	A	
1	2	update	B	
2	3	update	C	
3		checkpoint		
4	2	update	D	1
5	1	update	A	0
6	1	commit		5
7	1	end		6
8	3	update	C	2
9	2	update	D	4

**Dirty Page Table**

Page ID	recLSN
A	0
D	4

**Transaction Table**

Trans ID	Status	lastLSN
1	in progress	0
2	in progress	4
3	in progress	2

**Buffer Pool**

Page ID	pageLSN	Value

**Disk**

Page ID	pageLSN	Value
A	-1	1
B	1	two
C	2	three
D	9	seven

**ARIES Simulator**      [About ⓘ](#)

**Operations**

- W\_2(D, seven)
- Flush(D)
- W\_2(B, eight)
- W\_3(A, nine)

Controls: (or left and right arrow keys)

**Explanation**  
Current phase: **analysis**

Transaction 2 updated page D.  
Page D was brought into the dirty page table with recLSN 4.  
Transaction 2 was already in the transaction table.

**Log**  
LSN of last log record flushed to disk: 9

LSN	Trans ID	Type	Page ID	prevLSN
0	1	update	A	
1	2	update	B	
2	3	update	C	
3		checkpoint		
4	2	update	D	1
5	1	update	A	0
6	1	commit		5
7	1	end		6
8	3	update	C	2
9	2	update	D	4

**Dirty Page Table**

Page ID	recLSN
A	0
D	4

**Transaction Table**

Trans ID	Status	lastLSN
1	in progress	0
2	in progress	4
3	in progress	2

**Buffer Pool**

Page ID	pageLSN	Value
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**Disk**

Page ID	pageLSN	Value
A	-1	⊥
B	1	two
C	2	three
D	9	seven

**ARIES Simulator**      [About ⓘ](#)

**Operations**

- W\_2(D, seven)
- Flush(D)
- W\_2(B, eight)
- W\_3(A, nine)

Controls: (or left and right arrow keys)

**Explanation**  
Current phase: **analysis**

Transaction 1 updated page A.  
Page A was already in the dirty page table.  
Transaction 1 was already in the transaction table.

**Log**  
LSN of last log record flushed to disk: 9

LSN	Trans ID	Type	Page ID	prevLSN
0	1	update	A	
1	2	update	B	
2	3	update	C	
3		checkpoint		
4	2	update	D	1
5	1	update	A	0
6	1	commit		5
7	1	end		6
8	3	update	C	2
9	2	update	D	4

**Dirty Page Table**

Page ID	recLSN
A	0
D	4

**Transaction Table**

Trans ID	Status	lastLSN
1	in progress	5
2	in progress	4
3	in progress	2

**Buffer Pool**

Page ID	pageLSN	Value
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**Disk**

Page ID	pageLSN	Value
A	-1	⊥
B	1	two
C	2	three
D	9	seven

**ARIES Simulator**      [About ⓘ](#)

**Operations**

- W\_2(D, seven)
- Flush(D)
- W\_2(B, eight)
- W\_3(A, nine)

Controls: (or left and right arrow keys)

**Explanation**  
Current phase: **analysis**

Transaction 1 committed.  
Transaction 1 was already in the transaction table.  
Transaction 1's status was set to 'committed' in the transaction table.

**Log**  
LSN of last log record flushed to disk: 9

LSN	Trans ID	Type	Page ID	prevLSN
0	1	update	A	
1	2	update	B	
2	3	update	C	
3		checkpoint		
4	2	update	D	1
5	1	update	A	0
6	1	commit		5
7	1	end		6
8	3	update	C	2
9	2	update	D	4

**Dirty Page Table**

Page ID	recLSN
A	0
D	4

**Transaction Table**

Trans ID	Status	lastLSN
1	committed	6
2	in progress	4
3	in progress	2

**Buffer Pool**

Page ID	pageLSN	Value
---------	---------	-------

**Disk**

Page ID	pageLSN	Value
A	-1	⊥
B	1	two
C	2	three
D	9	seven

**ARIES Simulator**      [About ⓘ](#)

**Operations**

W_2(D, seven)
Flush(D)
W_2(B, eight)
W_3(A, nine)

Controls: (or left and right arrow keys)

**Explanation**  
Current phase: [analysis](#)

Transaction 1 ended and was removed from the transaction table.

**Log**  
LSN of last log record flushed to disk: 9

LSN	Trans ID	Type	Page ID	prevLSN
0	1	update	A	
1	2	update	B	
2	3	update	C	
3		checkpoint		
4	2	update	D	1
5	1	update	A	0
6	1	commit		5
7	1	end		6
8	3	update	C	2
9	2	update	D	4

**Dirty Page Table**

Page ID	recLSN
A	0
D	4

**Transaction Table**

Trans ID	Status	lastLSN
2	in progress	4
3	in progress	2

**Buffer Pool**

Page ID	pageLSN	Value
---------	---------	-------

**Disk**

Page ID	pageLSN	Value
A	-1	1
B	1	two
C	2	three
D	9	seven

**ARIES Simulator**      [About ⓘ](#)

**Operations**

W_2(D, seven)
Flush(D)
W_2(B, eight)
W_3(A, nine)

Controls: (or left and right arrow keys)

**Explanation**  
Current phase: [analysis](#)

Transaction 3 updated page C.  
Page C was brought into the dirty page table with recLSN 8.  
Transaction 3 was already in the transaction table.

**Log**  
LSN of last log record flushed to disk: 9

LSN	Trans ID	Type	Page ID	prevLSN
0	1	update	A	
1	2	update	B	
2	3	update	C	
3		checkpoint		
4	2	update	D	1
5	1	update	A	0
6	1	commit		5
7	1	end		6
8	3	update	C	2
9	2	update	D	4

**Dirty Page Table**

Page ID	recLSN
A	0
D	4
C	8

**Transaction Table**

Trans ID	Status	lastLSN
2	in progress	4
3	in progress	8

**Buffer Pool**

Page ID	pageLSN	Value
---------	---------	-------

**Disk**

Page ID	pageLSN	Value
A	-1	1
B	1	two
C	2	three
D	9	seven

**ARIES Simulator**      [About ⓘ](#)

**Operations**

W_2(D, seven)
Flush(D)
W_2(B, eight)
W_3(A, nine)

Controls: (or left and right arrow keys)

**Explanation**  
Current phase: [analysis](#)

Transaction 2 updated page D.  
Page D was already in the dirty page table.  
Transaction 2 was already in the transaction table.

**Log**  
LSN of last log record flushed to disk: 9

LSN	Trans ID	Type	Page ID	prevLSN
0	1	update	A	
1	2	update	B	
2	3	update	C	
3		checkpoint		
4	2	update	D	1
5	1	update	A	0
6	1	commit		5
7	1	end		6
8	3	update	C	2
9	2	update	D	4

**Dirty Page Table**

Page ID	recLSN
A	0
D	4
C	8

**Transaction Table**

Trans ID	Status	lastLSN
2	in progress	9
3	in progress	8

**Buffer Pool**

Page ID	pageLSN	Value
---------	---------	-------

**Disk**

Page ID	pageLSN	Value
A	-1	1
B	1	two
C	2	three
D	9	seven

**ARIES Simulator**

**About ⓘ**

**Operations** ↪

- W\_2(D, seven)
- Flush(D)
- W\_2(B, eight)
- W\_3(A, nine)

Controls: ⏪ ⏩ (or left and right arrow keys)

**Explanation**

Current phase: **analysis**

ARIES completed its analysis phase and marked in progress transactions as aborted.

**Log**

LSN of last log record flushed to disk: 9

LSN	Trans ID	Type	Page ID	prevLSN
0	1	update	A	
1	2	update	B	
2	3	update	C	
3		checkpoint		
4	2	update	D	1
5	1	update	A	0
6	1	commit		5
7	1	end		6
8	3	update	C	2
9	2	update	D	4

**Dirty Page Table**

Page ID	recLSN
A	0
D	4
C	8

**Transaction Table**

Trans ID	Status	lastLSN
2	aborted	9
3	aborted	8

**Buffer Pool**

Page ID	pageLSN	Value
---------	---------	-------

**Disk**

Page ID	pageLSN	Value
A	-1	⊥
B	1	two
C	2	three
D	9	seven

**ARIES Simulator**

**About ⓘ**

**Operations** ↪

- W\_2(D, seven)
- Flush(D)
- W\_2(B, eight)
- W\_3(A, nine)

Controls: ⏪ ⏩ (or left and right arrow keys)

**Explanation**

Current phase: **redo**

ARIES began its REDO phase at LSN 0: the smallest recLSN in the dirty page table.

Transaction 1 updated page A.

The update did not meet any of condition 1, 2, or 3 and so was redone.

Page A was fetched from disk and brought into the buffer pool.

**Log**

LSN of last log record flushed to disk: 9

LSN	Trans ID	Type	Page ID	prevLSN
0	1	update	A	
1	2	update	B	
2	3	update	C	
3		checkpoint		
4	2	update	D	1
5	1	update	A	0
6	1	commit		5
7	1	end		6
8	3	update	C	2
9	2	update	D	4

**Dirty Page Table**

Page ID	recLSN
A	0
D	4
C	8

**Transaction Table**

Trans ID	Status	lastLSN
2	aborted	9
3	aborted	8

**Buffer Pool**

Page ID	pageLSN	Value
A	0	one

**Disk**

Page ID	pageLSN	Value
A	-1	⊥
B	1	two
C	2	three
D	9	seven

**ARIES Simulator**

**About ⓘ**

**Operations** ↪

- W\_2(D, seven)
- Flush(D)
- W\_2(B, eight)
- W\_3(A, nine)

Controls: ⏪ ⏩ (or left and right arrow keys)

**Explanation**

Current phase: **redo**

Transaction 2 updated page B.

Condition 1 was met: page B was not in the dirty page table. So, the update was not redone.

**Log**

LSN of last log record flushed to disk: 9

LSN	Trans ID	Type	Page ID	prevLSN
0	1	update	A	
1	2	update	B	
2	3	update	C	
3		checkpoint		
4	2	update	D	1
5	1	update	A	0
6	1	commit		5
7	1	end		6
8	3	update	C	2
9	2	update	D	4

**Dirty Page Table**

Page ID	recLSN
A	0
D	4
C	8

**Transaction Table**

Trans ID	Status	lastLSN
2	aborted	9
3	aborted	8

**Buffer Pool**

Page ID	pageLSN	Value
A	0	one

**Disk**

Page ID	pageLSN	Value
A	-1	⊥
B	1	two
C	2	three
D	9	seven

**ARIES Simulator**      [About](#)

**Operations**

- W\_2(D, seven)
- Flush(D)
- W\_2(B, eight)
- W\_3(A, nine)

Controls: (or left and right arrow keys)

**Explanation**  
Current phase: **redo**

Transaction 3 updated page C.  
Condition 2 was met: page C was in the dirty page table, but its recLSN of 8 is greater than the LSN of this log entry: 2. So, the update was not redone.

**Log**  
LSN of last log record flushed to disk: 9

LSN	Trans ID	Type	Page ID	prevLSN
0	1	update	A	
1	2	update	B	
2	3	update	C	
3		checkpoint		
4	2	update	D	1
5	1	update	A	0
6	1	commit		5
7	1	end		6
8	3	update	C	2
9	2	update	D	4

**Dirty Page Table**

Page ID	recLSN
A	0
D	4
C	8

**Transaction Table**

Trans ID	Status	lastLSN
2	aborted	9
3	aborted	8

**Buffer Pool**

Page ID	pageLSN	Value
A	0	one

**Disk**

Page ID	pageLSN	Value
A	-1	⊥
B	1	two
C	2	three
D	9	seven

**ARIES Simulator**      [About](#)

**Operations**

- W\_2(D, seven)
- Flush(D)
- W\_2(B, eight)
- W\_3(A, nine)

Controls: (or left and right arrow keys)

**Explanation**  
Current phase: **redo**

Checkpoint log entries are not redone.

**Log**  
LSN of last log record flushed to disk: 9

LSN	Trans ID	Type	Page ID	prevLSN
0	1	update	A	
1	2	update	B	
2	3	update	C	
3		checkpoint		
4	2	update	D	1
5	1	update	A	0
6	1	commit		5
7	1	end		6
8	3	update	C	2
9	2	update	D	4

**Dirty Page Table**

Page ID	recLSN
A	0
D	4
C	8

**Transaction Table**

Trans ID	Status	lastLSN
2	aborted	9
3	aborted	8

**Buffer Pool**

Page ID	pageLSN	Value
A	0	one

**Disk**

Page ID	pageLSN	Value
A	-1	⊥
B	1	two
C	2	three
D	9	seven

**ARIES Simulator**      [About](#)

**Operations**

- W\_2(D, seven)
- Flush(D)
- W\_2(B, eight)
- W\_3(A, nine)

Controls: (or left and right arrow keys)

**Explanation**  
Current phase: **redo**

Transaction 2 updated page D.  
Condition 3 was met: the pageLSN of page D on disk was 9 which is greater than or equal to the LSN of this log entry: 4. So, the update was not redone.

**Log**  
LSN of last log record flushed to disk: 9

LSN	Trans ID	Type	Page ID	prevLSN
0	1	update	A	
1	2	update	B	
2	3	update	C	
3		checkpoint		
4	2	update	D	1
5	1	update	A	0
6	1	commit		5
7	1	end		6
8	3	update	C	2
9	2	update	D	4

**Dirty Page Table**

Page ID	recLSN
A	0
D	4
C	8

**Transaction Table**

Trans ID	Status	lastLSN
2	aborted	9
3	aborted	8

**Buffer Pool**

Page ID	pageLSN	Value
A	0	one

**Disk**

Page ID	pageLSN	Value
A	-1	⊥
B	1	two
C	2	three
D	9	seven

**ARIES Simulator**      [About](#)

**Operations**

- W\_2(D, seven)
- Flush(D)
- W\_2(B, eight)
- W\_3(A, nine)

Controls: (or left and right arrow keys)

**Explanation**  
Current phase: **redo**

Transaction 1 updated page A.  
The update did not meet any of condition 1, 2, or 3 and so was redone.

**Log**  
LSN of last log record flushed to disk: 9

LSN	Trans ID	Type	Page ID	prevLSN
0	1	update	A	
1	2	update	B	
2	3	update	C	
3		checkpoint		
4	2	update	D	1
5	1	update	A	0
6	1	commit		5
7	1	end		6
8	3	update	C	2
9	2	update	D	4

**Dirty Page Table**

Page ID	recLSN
A	0
D	4
C	8

**Transaction Table**

Trans ID	Status	lastLSN
2	aborted	9
3	aborted	8

**Buffer Pool**

Page ID	pageLSN	Value
A	5	five

**Disk**

Page ID	pageLSN	Value
A	-1	1
B	1	two
C	2	three
D	9	seven

**ARIES Simulator**      [About](#)

**Operations**

- W\_2(D, seven)
- Flush(D)
- W\_2(B, eight)
- W\_3(A, nine)

Controls: (or left and right arrow keys)

**Explanation**  
Current phase: **redo**

Commit log entries are not redone.

**Log**  
LSN of last log record flushed to disk: 9

LSN	Trans ID	Type	Page ID	prevLSN
0	1	update	A	
1	2	update	B	
2	3	update	C	
3		checkpoint		
4	2	update	D	1
5	1	update	A	0
6	1	commit		5
7	1	end		6
8	3	update	C	2
9	2	update	D	4

**Dirty Page Table**

Page ID	recLSN
A	0
D	4
C	8

**Transaction Table**

Trans ID	Status	lastLSN
2	aborted	9
3	aborted	8

**Buffer Pool**

Page ID	pageLSN	Value
A	5	five

**Disk**

Page ID	pageLSN	Value
A	-1	1
B	1	two
C	2	three
D	9	seven

**ARIES Simulator**      [About](#)

**Operations**

- W\_2(D, seven)
- Flush(D)
- W\_2(B, eight)
- W\_3(A, nine)

Controls: (or left and right arrow keys)

**Explanation**  
Current phase: **redo**

End log entries are not redone.

**Log**  
LSN of last log record flushed to disk: 9

LSN	Trans ID	Type	Page ID	prevLSN
0	1	update	A	
1	2	update	B	
2	3	update	C	
3		checkpoint		
4	2	update	D	1
5	1	update	A	0
6	1	commit		5
7	1	end		6
8	3	update	C	2
9	2	update	D	4

**Dirty Page Table**

Page ID	recLSN
A	0
D	4
C	8

**Transaction Table**

Trans ID	Status	lastLSN
2	aborted	9
3	aborted	8

**Buffer Pool**

Page ID	pageLSN	Value
A	5	five

**Disk**

Page ID	pageLSN	Value
A	-1	1
B	1	two
C	2	three
D	9	seven

**ARIES Simulator**

**About ⓘ**

**Operations** ↻

- W\_2(D, seven)
- Flush(D)
- W\_2(B, eight)
- W\_3(A, nine) ↴

Controls: ↪ ↩ (or left and right arrow keys)

**Explanation**

Current phase: **redo**

Transaction 3 updated page C.  
The update did not meet any of condition 1, 2, or 3 and so was redone.  
Page C was fetched from disk and brought into the buffer pool.

**Log**

LSN of last log record flushed to disk: 9

LSN	Trans ID	Type	Page ID	prevLSN
0	1	update	A	
1	2	update	B	
2	3	update	C	
3		checkpoint		
4	2	update	D	1
5	1	update	A	0
6	1	commit		5
7	1	end		6
8	3	update	C	2
9	2	update	D	4

**Dirty Page Table**

Page ID	recLSN
A	0
D	4
C	8

**Transaction Table**

Trans ID	Status	lastLSN
2	aborted	9
3	aborted	8

**Buffer Pool**

Page ID	pageLSN	Value
A	5	five
C	8	six

**Disk**

Page ID	pageLSN	Value
A	-1	⊥
B	1	two
C	2	three

**ARIES Simulator**

**About ⓘ**

**Operations** ↻

- W\_2(D, seven)
- Flush(D)
- W\_2(B, eight)
- W\_3(A, nine) ↴

Controls: ↪ ↩ (or left and right arrow keys)

**Explanation**

Current phase: **redo**

Transaction 2 updated page D.  
Condition 3 was met: the pageLSN of page D on disk was 9 which is greater than or equal to the LSN of this log entry: 9. So, the update was not redone.

**Log**

LSN of last log record flushed to disk: 9

LSN	Trans ID	Type	Page ID	prevLSN
0	1	update	A	
1	2	update	B	
2	3	update	C	
3		checkpoint		
4	2	update	D	1
5	1	update	A	0
6	1	commit		5
7	1	end		6
8	3	update	C	2
9	2	update	D	4

**Dirty Page Table**

Page ID	recLSN
A	0
D	4
C	8

**Transaction Table**

Trans ID	Status	lastLSN
2	aborted	9
3	aborted	8

**Buffer Pool**

Page ID	pageLSN	Value
A	5	five
C	8	six

**Disk**

Page ID	pageLSN	Value
A	-1	⊥
B	1	two
C	2	three

**ARIES Simulator**

**About ⓘ**

**Operations** ↻

- W\_2(D, seven)
- Flush(D)
- W\_2(B, eight)
- W\_3(A, nine) ↴

Controls: ↪ ↩ (or left and right arrow keys)

**Explanation**

Current phase: **undo**

ARIES began its UNDO phase by collecting the set of "losers LSNs": the lastLSNs of all transactions in the transaction table.  
The loser LSNs were 9,8.  
The largest loser LSNs was 9, so log entry 9 was undone. A CLR entry was appended to the log, the transaction table was updated accordingly, and the update was undone in the buffer pool.

**Log**

LSN of last log record flushed to disk: 9

LSN	Trans ID	Type	Page ID	prevLSN
0	1	update	A	
1	2	update	B	
2	3	update	C	
3		checkpoint		
4	2	update	D	1
5	1	update	A	0
6	1	commit		5
7	1	end		6
8	3	update	C	2
9	2	update	D	4
10	2	clr	D	9

**Dirty Page Table**

Page ID	recLSN
A	0
D	4
C	8

**Transaction Table**

Trans ID	Status	lastLSN
2	aborted	10
3	aborted	8

**Buffer Pool**

Page ID	pageLSN	Value
A	5	five
C	8	six
D	10	four

**Disk**

Page ID	pageLSN	Value
A	-1	⊥
B	1	two

**ARIES Simulator**

**About ⓘ**

**Operations ↕**

- W\_2(D, seven)
- Flush(D)
- W\_2(B, eight)
- W\_3(A, nine)

Controls: ⬅ ➡ (or left and right arrow keys)

**Explanation**

Current phase: **undo**

The loser LSNs were 8,4.  
The largest loser LSNs was 8, so log entry 8 was undone. A CLR entry was appended to the log, the transaction table was updated accordingly, and the update was undone in the buffer pool.  
The prevLSN of log entry 8 is 2 which is added to the loser LSNs.

**Log**  
LSN of last log record flushed to disk: 9

LSN	Trans ID	Type	Page ID	prevLSN
0	1	update	A	
1	2	update	B	
2	3	update	C	
3		checkpoint		
4	2	update	D	1
5	1	update	A	0
6	1	commit		5
7	1	end		6
8	3	update	C	2
9	2	update	D	4
10	2	clr	D	9
11	3	clr	C	8

**Dirty Page Table**

Page ID	recLSN
A	0
D	4
C	8

**Transaction Table**

Trans ID	Status	lastLSN
2	aborted	10
3	aborted	11

**Buffer Pool**

Page ID	pageLSN	Value
A	5	five
C	11	three
D	10	four

**Disk**

Page ID	pageLSN	Value
A	-1	1
B	1	two

**ARIES Simulator**

**About ⓘ**

**Operations ↕**

- W\_2(D, seven)
- Flush(D)
- W\_2(B, eight)
- W\_3(A, nine)

Controls: ⬅ ➡ (or left and right arrow keys)

**Explanation**

Current phase: **undo**

The loser LSNs were 4,2.  
The largest loser LSNs was 4, so log entry 4 was undone. A CLR entry was appended to the log, the transaction table was updated accordingly, and the update was undone in the buffer pool.  
The prevLSN of log entry 4 is 1 which is added to the loser LSNs.

**Log**  
LSN of last log record flushed to disk: 9

LSN	Trans ID	Type	Page ID	prevLSN
0	1	update	A	
1	2	update	B	
2	3	update	C	
3		checkpoint		
4	2	update	D	1
5	1	update	A	0
6	1	commit		5
7	1	end		6
8	3	update	C	2
9	2	update	D	4
10	2	clr	D	9
11	3	clr	C	8
12	2	clr	D	10

**Dirty Page Table**

Page ID	recLSN
A	0
D	4
C	8

**Transaction Table**

Trans ID	Status	lastLSN
2	aborted	12
3	aborted	11

**Buffer Pool**

Page ID	pageLSN	Value
A	5	five
C	11	three
D	12	1

**Disk**

Page ID	pageLSN	Value
A	-1	1
B	1	two

**ARIES Simulator**

**About ⓘ**

**Operations ↕**

- W\_2(D, seven)
- Flush(D)
- W\_2(B, eight)
- W\_3(A, nine)

Controls: ⬅ ➡ (or left and right arrow keys)

**Explanation**

Current phase: **undo**

The loser LSNs were 2,1.  
The largest loser LSNs was 2, so log entry 2 was undone. A CLR entry was appended to the log, the transaction table was updated accordingly, and the update was undone in the buffer pool.  
Log entry 2 was the first update of transaction 3, so an end log entry was appended to the log to end transaction 3, and it was removed from the transaction table.

**Log**  
LSN of last log record flushed to disk: 9

LSN	Trans ID	Type	Page ID	prevLSN
0	1	update	A	
1	2	update	B	
2	3	update	C	
3		checkpoint		
4	2	update	D	1
5	1	update	A	0
6	1	commit		5
7	1	end		6
8	3	update	C	2
9	2	update	D	4
10	2	clr	D	9
11	3	clr	C	8
12	2	clr	D	10
13	3	clr	C	11
14	3	end		13

**Dirty Page Table**

Page ID	recLSN
A	0
D	4
C	8

**Transaction Table**

Trans ID	Status	lastLSN
2	aborted	12

**Buffer Pool**

Page ID	pageLSN	Value
A	5	five
C	13	1
D	12	1

**Disk**

Page ID	pageLSN	Value
A	-1	1
B	1	two
C	2	three

**ARIES Simulator**

**About ⓘ**

**Operations** ↕

- W\_2(D, seven)
- Flush(D)
- W\_2(B, eight)
- W\_3(A, nine)

Controls: ⏪ ⏩ (or left and right arrow keys)

**Explanation**

Current phase: **undo**

The loser LSNs were 1.  
The largest loser LSNs was 1, so log entry 1 was undone. A CLR entry was appended to the log, the transaction table was updated accordingly, and the update was undone in the buffer pool.  
Page B was fetched from disk and brought into the buffer pool.

**Log**

LSN of last log record flushed to disk: 9

LSN	Trans ID	Type	Page ID	prevLSN
0	1	update	A	
1	2	update	B	
2	3	update	C	
3		checkpoint		
4	2	update	D	1
5	1	update	A	0
6	1	commit		5
7	1	end		6
8	3	update	C	2
9	2	update	D	4
10	2	clr	D	9
11	3	clr	C	8
12	2	clr	D	10
13	3	clr	C	11
14	3	end		13
15	2	clr	B	12
16	2	end		15

**Dirty Page Table**

Page ID	recLSN
A	0
D	4
C	8

**Transaction Table**

Trans ID	Status	lastLSN
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**Buffer Pool**

Page ID	pageLSN	Value
A	5	five
C	13	1
D	12	1
B	15	1

**Disk**

Page ID	pageLSN	Value
A	-1	1
B	1	two
C	2	three

**ARIES Simulator**

**About ⓘ**

**Operations** ↕

- W\_2(D, seven)
- Flush(D)
- W\_2(B, eight)
- W\_3(A, nine)

Controls: ⏪ ⏩ (or left and right arrow keys)

**Explanation**

Current phase: **undo**

ARIES finished! The effects of all committed transactions have been applied, and the effects of all aborted transactions have been reverted.

**Log**

LSN of last log record flushed to disk: 9

LSN	Trans ID	Type	Page ID	prevLSN
0	1	update	A	
1	2	update	B	
2	3	update	C	
3		checkpoint		
4	2	update	D	1
5	1	update	A	0
6	1	commit		5
7	1	end		6
8	3	update	C	2
9	2	update	D	4
10	2	clr	D	9
11	3	clr	C	8
12	2	clr	D	10
13	3	clr	C	11
14	3	end		13
15	2	clr	B	12
16	2	end		15

**Dirty Page Table**

Page ID	recLSN
A	0
D	4
C	8

**Transaction Table**

Trans ID	Status	lastLSN
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**Buffer Pool**

Page ID	pageLSN	Value
A	5	five
C	13	1
D	12	1
B	15	1

**Disk**

Page ID	pageLSN	Value
A	-1	1
B	1	two
C	2	three

## 8. Post Experimental Exercise-

### A. Questions:

1. Write note on checkpoints
2. Explain Three phases of Aries recovery technique
3. Explain shadow paging

### B. Conclusion:

1. Write what was performed in the experiment
2. Mention few applications of what was studied.
3. Write the significance of the studied topic

### C. References:

- [1] Elmasri and Navathe, “Fundamentals of Database Systems”, 5th Edition, PEARSON Education.
- [2] Korth, Silberchatz, Sudarshan, “Database System Concepts”, 6th Edition, McGraw – Hill
- [3] [https://www.w3schools.com/sql/sql\\_default.asp](https://www.w3schools.com/sql/sql_default.asp)

# Josh Kahajan SE IT B 04

## Pras experiment Exercise

### Brief Theory :-

Q.1. What is recovery? -

Database Recovery is the process of restoring the database to a correct (consistent) state in event of a failure.

In other words, it is a process of restoring the database to the most recent consistent state that existed shortly before the time of system failure.

The main element of database recovery is the most recent database backup. If you maintain database backup regularly, recovery becomes straight forward.

### Log Based Recovery:-

Log is a sequence of records, which maintains the records of actions performed by a transaction. It is important that the log are written prior to the actual modifications and stored on a stable storage media.

Log Based recovery works as follows.

The log file is kept on a safe media. When the transaction enters the system and starts execution it writes a log about it.

$\langle Tn, start \rangle$

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When the transaction modifies an item X,  
it writes a log  $\langle T_n, X, V_1, V_2 \rangle$

When a transaction finishes execution  
it writes a log  $\langle T_n, \text{commit} \rangle$   
The database can be modified using two  
approaches.

Deferred database modification :- All logs are  
written on to the stable storage and  
the database is updated when a transaction  
commits.

Two Immediate commits :-

Immediate database modification :- Each log  
follows as actual database modification.

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## Post Experiment Exercise:

### A Questions

1)

Write a note on checkpoints.

A database checkpoint is where all committed transactions are written to the redo / audit log.

The database administrator determines the frequency of the checkpoints based on volume of transactions.

When a system fails, it checks log to determine recovery action.

Too frequent checkpoints can affect the system performance.

A database checkpoint keeps track of change of information and enables incremental database backup.

2)

Explain three phases of aries recovery technique.

The three phases of aries recovery technique are:

1) Analysis:- The analysis step identifies the dirty pages in the buffer and set of transactions active at the time of crash. The appropriate point in the log where the redo operation should start is also determined.

2) Redo:- The redo phase actually reappplies updates from the log to the database. Generally

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the redo operation is applied to only committed operations. However in ARIES this is not the case. certain information in the aries log will provide the start point for redo from which redo operations are applied until the end of the log is reached.

Undo : During the undo phase, the log is scanned backwards and the operations of transactions that were active at time of crash are undone in reverse order. The information needed for ARIES to accomplish its recovery procedure includes the log, the transaction table and the dirty page table.

Q 3. Explain Shadow Paging?

Shadow paging is recovery technique that is used to recover database. In this recovery technique database is considered as made up of fixed size of logical units of storage which are referred as pages.

Pages are mapped into physical blocks of storage with help of the page table which allows one entry for each logical page of database. This method uses two page tables named as current page and shadow page.

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### B) Conclusion :-

In this experiment we have performed and implemented ARIES recovery technique to recover a database from failed stage.

Recovery from ~~non~~ transaction failures usually means that the database is restored to the most recent consistent state before the failure occurs. This is necessary to maintain the ACID properties of the database.

In case of system failure or a crash, the effect of all the ~~the~~ transactions at the time of failure can contradict the property of atomicity. To ensure the database is at a consistent state, ~~the~~ recovery methods like ARIES are used.