

Principles of Computer Systems Design

Assignment 2

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Question 1: Recovery Concepts

1. In a system implementing force and no-steal, is it necessary to implement a scheme for redo? What about a scheme for undo? Explain why.

In a system like this, we do not have to implement a scheme for redo because the force approach is used, which according to the theory means that we do not have to redo the changes of a committed transaction if there is a subsequent crash. As a result, all these changes are guaranteed to have been written to disk at the time the data has been committed.

If a no-steal approach is used, we also do not have to undo the changes of an aborted transaction (because these changes have not been written to disk),

2. What is the difference between nonvolatile and stable storage? What types of failures are survived by each type of storage?

According to the theory, a volatile memory is one whose mechanism of retaining information consumes energy. If its power supply is interrupted for some reason, it forgets its information content. Such a memory is RAM. On the other hand a stable or non-volatile storage retains its content even if the power supply is interrupted. When power is again available, READ operations return the same values as before.

3. In a system that implements Write-Ahead Logging, which are the two situations in which the log tail must be forced to stable storage? Explain why log forces are necessary in these situations and argue why they are sufficient for durability.

A situation in which the log tail is forced to stable storage, is when a transaction is committed, even if a no-force approach is being used. TODO TODO TODO

Question 2: ARIES

LSN	LAST_LSN	TRAN_ID	TYPE	PAGE_ID
1	-	-	begin CKPT	-
2	-	-	end CKPT	-
3	NULL	T1	update	P2
4	3	T1	update	P1
5	NULL	T2	update	P5
6	NULL	T3	update	P3
7	6	T3	commit	-
8	5	T2	update	P5
9	8	T2	update	P3
10	6	T3	end	-

Table 1: The LOG before the crash

1. To create the *Transaction* and *Dirty Page* tables we need to go through the *Analysis Phase*. The algorithm states that we must reconstruct these tables after the last *end CKPT* mark. We scan the log forward from *LSN 3* and add the transactions in the *Transaction Table* that have not encountered an *end* record. We update the transaction's *last LSN* entry by updating it to the current LSN of the transaction. The *Transaction table* after the analysis phase would look like this:

Tx ID	Status	LastLSN
T1	active	4
T2	active	9

Table 2: Transaction Table

For the *Dirty Page table*, we need to check the *update* records in the log. We need to store the earliest LSN for that page modification. If the a page is modified by a transaction that has successfully ended its commit action, we remove it from the *Dirty Page table*. The *Dirty Page table* is presented below:

Page ID	recLSN
P2	3
P1	4
P5	5

Table 3: Dirty Page Table

- 2.
- 3.

- 4.
- 5.
- 6.

Programming Task

Testing

Questions for Discussion on the Performance Measurements

Discuss in detail the setup you have created for your experiments. In particular, document your data generation procedures, hardware employed, measurement procedures (e.g., number of repetitions, statistics used such as average or deviation), and any other considerations you made. In the evaluation of this question, we will consider not only your thoroughness, but also whether you provide a brief justification/rationale for your decisions.

Show and explain the plots for throughput and latency that you obtained. As described above, we expect two plots: one for throughput and one for latency. Each plot should include two curves: one for executions in the same address space, and one for executions across address spaces. Describe the trends observed and any other effects. Explain why you observe these trends and how much that matches your Expectations.

How reliable are the metrics and the workloads for predicting the performance of the bookstore? Are the metrics well chosen? What additional metrics would you choose to demonstrate the performance of the bookstore?