

Solution

1.

- a) No. Uncommitted data is never written to disk.
- b) Yes. Some committed data might have not been written to disk yet.
- c) Yes. Some uncommitted might have been written to disk.
- d) Yes. We need to repeat history, including looser transactions, before starting the UNDO phase.
- e) Begin_checkpoint of the most recent checkpoint
- f) Smallest recLSN in dirty page table at the end of Analysis
- g) Oldest log record of transactions active at crash

2.

- a) Analysis determines that the last begin_checkpoint was at LSN 00 and starts at the corresponding end_checkpoint (LSN 10). Transaction Table records are denoted as (transID, lastLSN, status) and Dirty Page Table records are denoted as (pageID, recLSN) sets. Analysis phase runs till LSN 70 and does the following:

LSN 20 Adds (T1, 20, U) to TT and (P5, 20) to DPT
 LSN 30 Adds (T2, 30, U) to TT and (P3,30) to DPT
 LSN 40 Changes (T2, 30, U) to (T2, 40, C)
 LSN 50 Deletes entry for T2 from Transaction Table
 LSN 60 Adds (T3, 60, U) to TT. Does not change P3 entry in DPT
 LSN 70 Adds (P2, 70) to DPT
 and Changes (T1, 20, U) to (T1, 70, U)
 LSN 80 Changes (T1, 70, U) to (T1, 80, U)

The final Transaction Table has two entries: (T1, 80, U), and (T3, 60, U).
 The final Dirty Page Table has three entries (P5,20), (P3,30), and (P2, 70).

b)

LSN 20 P5 is retrieved and its pageLSN is checked. If the page had been written to disk before the crash (i.e. if pageLSN \geq 20), nothing is redone otherwise the changes are redone.
 LSN 30 P3 is retrieved and its pageLSN is checked. If the page had been written to disk before the crash (i.e. if pageLSN \geq 30), nothing is redone otherwise the changes are redone.
 LSN 40 No action
 LSN 50 No action
 LSN 60 P3 is retrieved and its pageLSN is checked. If the page had been written to disk before the crash (i.e. if pageLSN \geq 60), nothing is redone otherwise the changes are redone.
 LSN 70 P2 is retrieved and its pageLSN is checked. If the page had been written to disk before the crash (i.e. if pageLSN \geq 70), nothing is redone otherwise the changes are redone.
 LSN 80 No action

- c) UNDO phase starts at LSN 80 (highest lastLSN in TT). The Loser Set consists of LSNs 80 and 60.
- LSN 80 Removes 80 from the Loser Set. Adds LSN 70 to the Loser Set. Loser Set = (70, 60).
 - LSN 70 Removes 70 from the Loser Set. Undoes the change on P2 and adds a CLR indicating this Undo (LSN 90, undoNextLSN = 20). Loser Set = (60, 20).
 - LSN 60 Undoes the change on P3 and adds a CLR indicating this Undo (LSN 100, undoNextLSN = null). Loser Set = (20).
 - LSN 20 Undoes the change on P5 and adds a CLR indicating this Undo (LSN 110, undoNextLSN = null).