CS245 Database System Principles - Winter 2001

- PLEASE write your serial number on the top of your first page.
- This assignment is due in class on Thursday, March 1st.
- State all assumptions.
- Email questions to **cs245ta-win01@lists.stanford.edu**.

Assignment 6

Problem 1 (25 points)

Consider a system that uses *undo logging* and produces the following sequence of log records (in exactly this order):

`<START>; <T, A, 10>; <T, B, 20>; <T, C, 30>; <T, D, 40>; <COMMIT T>`

One possible sequence of actions that leads to these log records is:

Log(A); Log(B); Write(A); Log(C); Write(B); Log(D); Write(C); Write(D); Log(Commit);

In this sequence, Log(X) represents the action that writes to disk the log record for action X, and Write(X) represents the action that updates object X on disk.

Give *all* possible legal sequences of actions (with undo logging) that satisfy all of the following three conditions:

- the sequence of actions can yield the given log sequence;
- Write(A) is before Log(C);
- Write(B) is before Log(D).

To give the sequences, use the same notation as for the example action sequence.

Problem 2 (30 points)

The following is a sequence of undo-log records written by two transactions *T* and *U*:

`<START T>; <T, A, 10>; <START U>; <U, B, 20>; <T, C, 30>; <U, D, 40>; <COMMIT U>; <T, E, 50>; <COMMIT T>.`

Describe the actions of the recovery manager, including changes to both disk and the log, if there is a crash and the last log record that appears on disk is:

a) `<START U>`
b) `<T, E, 50>`
c) `<COMMIT T>`

Problem 3 (25 points)

Consider a system that uses *redo logging* and produces the following sequence of log records (in exactly this order):

```
<START>; <T, A, 10>; <T, B, 20>; <T, C, 30>; <T, D, 40>; <COMMIT T>
```

Give *all* possible legal sequences of actions (with redo logging) that satisfy all of the following three conditions:

- the sequence of actions can yield the given log sequence;
- Write(A) is before Write(C);
- Log(B) is before Log(D).

To give the sequences, use the notation of Problem 1.

Problem 4 (20 points)

Consider the following transaction log from the start of the run of a database system that is capable of running undo/redo logging with checkpointing:

```
1) <START T1>
2) <T1, A, 50, 10>
3) <START T2>
4) <T1, B, 130, 10>
5) <T1, A, 70, 50>
6) <T2, C, 20, 10>
7) <T2, D, 30, 10>
8) <COMMIT T1>
9) <START T3>
10)<T3, E, 60, 10>
11)<T2, D, 40, 30>
12)<START CKPT (T2,T3)>
13)<T2, C, 70, 20>
14)<COMMIT T2>
15)<START T4>
16)<T4, F, 100, 10>
17)<T4, G, 110, 10>
18)<COMMIT T3>
19)<T4, F, 150, 100>
20)<END CKPT>
21)<T4, F, 140, 150>
22)<COMMIT T4>
```

Assume the log entries are in the format

```
<Tid, Variable, New value, Old value>
```

What is the value of the data items *A*, *B*, *C*, *D*, *E*, *F*, and *G* on disk after recovery:

a) if the system crashes just before line *10* is written to disk?
b) if the system crashes just before line *15* is written to disk?
c) if the system crashes just before line *16* is written to disk?
d) if the system crashes just before line *19* is written to disk?
e) if the system crashes just before line *22* is written to disk?
f) if the system crashes just after line *22* is written to disk?