UMEÅ UNIVERSITY, DEPARTMENT OF COMPUTING SCIENCE

Written Assignment 3 (30 points)

Distributed Systems - 5DV147

You need to complete and submit this assignment individually. Collaboration is permitted only as described in the Guidelines for compulsory assignments and the Honor code. You need to submit this assignment by October 17 at 13:30 (hard deadline). You can either email your solution to us (5dv147-staff(at)cs.umu.se) or drop off your solution in the box outside the department.

1 SERIALIZABILITY (4 POINTS)

Assume the following two transactions:

T_1 : $_{(1)}$ read A, $_{(2)}$ B = A + 1

T_2 : $_{(3)}$ read B, $_{(4)}$ A = B + 2

Both A and B initial value is 1.

1. Show all possible legal schedules. **(1 point)**
2. What are the results of consistent execution of the transactions? **(1 point)**
3. Using two-phase locking concurrency control protocol:
   - What are the feasible schedules? **(1 point)**
   - What are the deadlock schedules? **(1 point)**

2 Optimistic concurrency control (6 Points)

A server manages the objects $a_1, a_2, ..., a_n$. The server provides two operations for its clients:

read(i)	returns the value of a_1
write(i, Value)	assigns *Value* to a_1

Transactions *T* and *U* are defined as follows:

T: x = read(i); write(j, 44);
U: write(i,55); write(j,66);

Consider optimistic concurrency control as applied to transactions *T* and *U*. Suppose that transactions *T* and *U* are active at the same time as one another. Describe the outcome in each of the following cases:

- *T*'s request to commit comes first and backward validation is used.
- *U*'s request to commit comes first and backward validation is used.
- *T*'s request to commit comes first and forward validation is used.
- *U*'s request to commit comes first and forward validation is used.

In each case describe the sequence in which the operations of *T* and *U* are performed, remembering that writes are not carried out until after validation. (**1.5 points each**)

3 Two-phase commit (10 Points)

In the two-phase commit protocol the participants are in an *uncertain* state after having emitting their votes and while waiting for a **doCommit** or **doAbort** message from the coordinator. While they are in this state they hold locks to objects that other transactions may want to access. For this reason it is desirable to reduce this uncertainty period.

Investigate and present strategies (at least two) that can be used to minimize the period in which participants are uncertain.

4 Peer-to-Peer (10 Points)

There are two classes of P2P overlay networks: *structured* and *unstructured.*

1. What are the tasks of an overlay network (in P2P systems)? Give a brief description about the two types of overlays. (**3 points**)

2. Compare the advantages and disadvantages, if any, of the two overlays from the perspectives of nodes (join/leave) and content (insert/search) operations. (**5 points**) Finally, describe how the two classes of overlays are affected by these operations. (**2 points**)