CS348: Introduction to Database Systems

Assignment 4 (no due date; to be used as a study guide)

Overview: This assignment consists of four questions and serves as a study guide for topics on normalization theory and on transactions.

Question 1.

Do Exercise 19.7, where only 1NF, 3NF and BCNF are considered in Part (b), and Exercise 19.10 on Pages 644 and 645 of the course textbook.

Question 2.

Determine whether or not each of the following four transaction execution histories is serializable. If a history is serializable, specify a serial order of transaction execution to which it is equivalent.

$H_1 = r_1[x] \ r_2[y] \ w_2[x] \ r_1[z] \ r_3[z] \ w_3[z] \ w_1[z]$
$H_2 = w_1[x] \ w_1[y] \ r_2[u] \ w_2[x] \ r_2[y] \ w_2[y] \ w_1[z]$
$H_3 = w_1[x] \ w_1[y] \ r_2[u] \ w_1[z] \ w_2[x] \ r_2[y] \ w_1[u]$
$H_4 = w_1[x] \ w_2[u] \ w_2[y] \ w_1[y] \ w_3[x] \ w_3[u] \ w_1[z]$

Question 3.

Consider the following sequence of requests. If the database system uses strict two-phase locking, will any of these requests cause a transaction to block? If so, indicate which will block. Will deadlock occur? Taking blocking into account, give an execution order which could result from these requests. Is your execution order serializable?

T_1: read x
T_2: read x
T_3: write x
T_2: read y
T_1: read y
T_1: read z
T_1: commit
T_4: write z
T_2: commit
T_5: write z
T_4: abort
T_3: commit
T_5: commit

Question 4.

Suppose that after a system failure, the transaction log looks as shown below (the log tail is at the bottom). A log entry (T_i,X,a,b) indicates that transaction T_i updated object X, changing its value from a to b.

Describe what the database system must do to recover from the system failure. Indicate which objects must be modified, and in what order those modifications occur. Indicate which transactions are committed and which are aborted after the failure recovery is complete.

(T_1,begin)
$(T_1,X,0,10)$
(T_2,begin)
$(T_2,Y,10,20)$
(T_3,begin)
(T_1,commit)
$(T_3,X,10,400)$
(T_4,begin)
$(T_3,Z,0,100)$
(T_5,begin)
$(T_4,A,0,1)$
(T_6,begin)
(T_4,abort)
$(T_5,A,0,2)$
(T_3,commit)
$(T_6,X,400,0)$
(T_5,commit)
$(T_6,A,2,3)$