27/11/17

Indian Institute of Engineering Science and Technology, Shibpur
Five year Dual Degree (B.Tech-M.Tech) 5^{th} Semester (CST) Examination, 2017
Database Management System (CS 501)
Answer any 5 questions

F.M. 70 Time: 3 hrs

1. (a) Draw the state diagram, and discuss the typical states that a transaction goes through during execution.

(b) Consider the three transactions T_1, T_2, and T_3 and schedules S_1 and S_2 given below. Draw the precedence graphs for S_1 and S_2 and state whether each schedule is serializable or not. If a schedule is serializable, write down the equivalent serial schedule(s).

$T_1 : r_1(X); w_1(X); r_1(Y); w_1(Y);$
$T_2 : r_2(Z); r_2(Y); w_2(Y); r_2(X); w_2(X);$
$T_3 : r_3(Y); r_3(Z); w_3(Y); w_3(Z);$
$S_1 : r_2(Z); r_2(Y); w_2(Y); r_3(Y); r_3(Z); r_1(X); w_1(X); w_3(Y); w_3(Z); r_2(X); r_1(Y); w_1(Y); w_2(X);$
$S_2 : r_3(Y); r_3(Z); r_1(X); w_1(X); w_3(Y); w_3(Z); r_2(Z); r_1(Y); w_1(Y); r_2(Y); w_2(Y); r_2(X); w_2(X);$

[6 + 8]

2. (a) Prove that the basic two-phase protocol guarantees conflict serializability of schedules.

(b) Apply the timestamp ordering algorithm to the schedule as given below and determine whether the algorithm will allow the execution of the schedule.
$S_3 : r_3(Y); r_3(Z); r_1(X); w_1(X); w_3(Y); w_3(Z); r_2(Z); r_1(Y); w_1(Y); r_2(Y); w_2(Y); r_2(X); w_2(X);$

[5 + 9]

3. (a) What are the different methods used for implementing joins? Discuss the main heuristics that are applied during query optimization?

(b) A file of 1024 blocks is to be sorted with an available buffer space of 5 blocks. External sort-merge is applied on the file for sorting. Calculate the *degree of merging* and the number of passes that will be required in the merge phase of the algorithm. [(3 + 6) + 5]

4. (a) What are the differences between a clustering index and a secondary index?

(b) Consider a disk with block size $B = 512$ bytes. A block pointer $P = 6$ bytes long and a record pointer $P_r = 7$ bytes long. A file has $r = 30000$ STUDENT records and the size of each record = 115 bytes long. Suppose the file is not ordered by the key field and we want to construct a B^+ tree access structure on key field. Calculate (i) the order p of the internal node and the order p_l of the leaf node of the B^+ tree; (ii) the number of leaf-node blocks needed if blocks are approximately 69% full (rounded up for convenience); (iii) the number of levels needed if the internal nodes are also 69% full (rounded up for convenience); (iv) the total number of blocks required by the B^+ tree; (v) number of block accesses needed to search for and retrieve a record from the file given a key field.

5. (a) Define Boyce-Codd normal form. How does it differ from $3NF$?

(b) Consider the relation R, which has attributes that hold schedules of courses and sections at a university; R = CourseNo(C), SecNo(SN), OfferingDept(OD), Credit-hours(CH); Course-level(CL), InstructorID(I), Semester(S), Year(Y), Days-hours(D), RoomNo(RM), NoOfStudents(NS) Suppose the following functional dependencies hold on R:
$C \rightarrow \{OD, CH, CL\}$ $\{C, SN, S, Y\} \rightarrow \{D, RM, NS, I\}$ $\{RM, D, S, Y\} \rightarrow \{I, C, SN\}$
Determine which sets of attributes form keys of R. How would you normalize this relation?

[5 + 9]

6. (a) What are checkpoints? List the actions taken by the recovery manager during checkpointing.

(b) What are the differences between deferred update technique of recovery and immediate update method of recovery?

[5 + 9]

7. Write short notes on the following:

(i) Shadow Paging

(ii) Database Trigger

[6 + 8]