BIRLA INSTITUTE OF TECHNOLOGY & SCIENCE, PILANI
Hyderabad Campus
Comprehensive Examination (2nd semester 2019-20) Cycle-2

Date: 08-Jan-2021 FN
Course: Database Systems (CS F212) **Max Mrks:90** **Total Duration: 2Hrs.**

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Q.1. Assume that we need to capture the data about Student and Hostel-room allotment, for a University campus.

i) We capture details of Hostels like- hostel_name (unique), warden, phone (there can be multiple phones), capacity, Location.

ii) Hostels have rooms. Every Room has – room#, floor, capacity, type (single, double etc) as attributes. The room# is unique within a Hostel, but may repeat for different Hostels (Ex: Room#:101 may be there in one or more hostels). But no hostel can have two rooms with same room#.

iii) There are Students who are allotted hostel-rooms. A student has name, studentID(unique), address, phone-contact (personal and home, only two contact numbers) as attributes. One student is allotted only one room. Every student is allotted a hostel room. Some rooms may be vacant. Each hostel has 100 or more rooms. Each student belongs to exactly one Department. A department has name (unique), HOD, Location as attributes. Every department has at least 30 students.

Now, draw the **ER** diagram for the above description. Indicate- cardinality, keys, attributes, min-max, and participation constraints for entity-types involved in the relationships. If found missing, assume necessary data. [12]

Q.2. Design an appropriate *Relational Database Schema* that captures all the information and constraints that are depicted in ER diagram you have drawn, as an answer to Q1., above. [12]

Q3. Look at the following Database schema.

Student(*sid, sname, sbranch, sage****)***

Club(*clubname, facultyIncharge, startYear****)*** *//info about student clubs*

Student_Club(*sid, clubname****)*** *//to capture student club membership details; sid is FK to sid of Student and clubname is FK to clubname of Club relation.*

Now, write Relational Algebra and also SQL queries to:

a) Get the *clubname* for those clubs having only 'EEE' branch students as members. (i.e all members of those clubs must belong to EEE branch only).

b) Get the *sid* and *sname* for those students who are members of all clubs for which Prof.Raman is the facultyIncharge. (i.e, they may be members of other clubs fine, but must be members of all clubs for which Prof.Raman is the facultyIncharge, please note this point).

c) Get the name of the student and the number of clubs he is having membership, for each non-CSE student.

Note: you don't have to rename any attribute in the result. It is not required.

[4X6=24]

Q4. Assume a situation where we have 10,50,000 records of **EMP** table to be stored in a file. The EMP table has fields- *eid* (10 bytes and PK), *ename* (30 bytes), *eage* (5 bytes), *esal*(5 bytes) , *address* (40 bytes). The disk block size is 1024 Bytes. The address of any disk block needs 6 Bytes. The records in file are ordered based on *eid*. We need to build/design a three-level indexing on the field *eid*. We assume unspanned record organization.

Now answer the following.

(i) How many data blocks are needed to store data records.

(ii) How many index blocks are needed at each level.

(iii) Give the number of block accesses needed (worst case) to retrieve a record with given *eid* value from the file without using indexing structure.

(iv) Give the number of block accesses needed (worst case) to retrieve a record with given *eid* value from the file with using only two levels of indexing scheme.

(v) Give the number of block accesses needed (worst case) to retrieve a record with given *eid* value from the file with using all three levels of the indexing scheme.

[2+3+3+3+3=14]

Q5. Assume that we have a relation ***R*** with schema ***R(A,B,C,D,E,F,G)*** , with the following set (***F)*** of functional dependencies. ***F={AB→CDEFG; C→B; A→D; E→G}*** . Give a decomposition of **R** into **R1**, **R2**, and **R3**, such that the highest Normal Form satisfied by R1 is 3NF, R2 is 2NF, and R3 is BCNF. [4+4+4=12]

Q6.(a) Give the formula to calculate the (i)cylinder capacity (in MB), and (ii) Diskpack capacity (in GB) if we know the block size (in KB), number of surfaces used to store data, number of tracks per surface and number of blocks per track, in a Diskpack with uniform structure, meaning all tracks have same number of blocks, all surfaces have same number of tracks.
(1KB=1024 Bytes; 1MB=1024 KB ; 1GB= 1024MB).

(b) Determine if the schedule S2 is conflict equivalent to S1, for the concurrent transactions 1 and 2 . The data items are A and B. Give reasoning. Not just YES or NO.

Schedule 1: $r_1(A)$; $w_1(A)$; $r_2(A)$; $r_1(B)$; $w_2(A)$; $w_1(B)$; $r_2(B)$; $w_2(B)$;
Schedule 2: $r_1(A)$; $w_1(A)$; $r_1(B)$; $r_2(A)$; $w_1(B)$; $w_2(A)$; $r_2(B)$; $w_2(B)$;

Note: Here, $r_1(A)$; - means that the transaction-1 reads data item A
$w_2(B)$; - means that the transaction-2 writes data item B

[4+4=8]

Q7. In a certain log-based recovery system, following entries are seen in a partial log.

[T2, start]; [T1, start]; [T1, A, 10, 60]; [T1, P, 30, 80]; [T2, B, 30, 50]; [T3, start]; [T3, B, 10, 15]; [T3, commit]; [Checkpoint]; [T1, C, 10, 5]; [T4, start]; [T1, commit]; [T2, D, 28, 30] ; [T4, F, 101, 302]; [T5, start]; [T5, M, 15, 20]; [T5, commit]; [T1, P, 110, 180]; [T2, commit]; //***System Crash***//.

Now for each transaction appearing the log, give actions need to be taken during the recovery process on System crash as shown, if *immediate modification* technique is used.

Please note that the Entry- [T1, P, 110, 180]; means that the transaction T1 modified data item P, old value is 110 and the new value is 180. [8]

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