14 September 2021

EAST WEST UNIVERSITY
Department of Computer Science and Engineering
B.Sc. in Computer Science and Engineering Program
Final Assessment (Online), Summer 2021 Semester

Course: CSE 302 Database Systems
Instructor: Mohammad Rezwanul Huq, Ph.D., Associate Professor, CSE Department
Full Marks: 100 (15 will be counted for final grading)
Time: 1 Hour 30 Minutes + 10 Minutes for uploading the answer

Note: There are **6** (**SIX**) questions. Answer ALL of them. The Mark of each question is mentioned at the right margin.

1. Consider the following relation 'Work' that stores information about projects in a large business. [24]

projName	projMgr	empId	hours	empName	budget	startDate	salary	empMgr	empDept	empRating
Jupiter	Sayed	E101	25	Jony	100000	01/15/04	60000	Liton	10	9
Jupiter	Sayed	E105	40	Alam	100000	01/15/04	55000	Jony	12	7
Jupiter	Sayed	E110	10	Rohit	100000	01/15/04	43000	Liton	10	8
Maxima	Labib	E101	15	Jony	200000	03/01/04	60000	Liton	10	8
Maxima	Labib	E110	30	Rohit	200000	03/01/04	43000	Liton	10	7
Maxima	Labib	E120	15	Tanni	200000	03/01/04	45000	Jony	12	9

We make the following assumptions.

i. Each project has a unique name.
ii. Names of employees and managers are not unique.
iii. The attribute `projMgr` stores the name of the manager of the project.
iv. A project can have many employees and an employee can also work on many projects. The attribute `hours` tells the number of hours per week a particular employee is assigned to work on a particular project.
v. The attribute `empMgr` gives the name of the employee's manager, who might not be the same as the project manager.
vi. The attribute `empDept` gives the employee's department. Department names are unique. The employee's manager is the manager of the employee's department.
vii. The attribute `rating` gives the employee's performance rating for a particular project. The project manager assigns the rating at the end of the employee's work on that project.
viii. The rest of the attributes are self-explanatory.

Answer the following questions.

a) Determine the primary key of the Work relation and justify your answer. (4 marks)

b) How does delete anomaly can occur in the Work relation? Explain with an example. (4 marks)

c) Normalize the Work relation up to 3NF level. Explain your process at each step in detail. (12 marks)

d) Show the decomposed relations that you have obtained finally with the available data. (4 marks)

2. Consider the following relation EmpRoleProject. [10]

empName	role	projName
Sayed	Designer	Jupiter
Sayed	Programmer	Maxima
Jony	Designer	Maxima
Tanni	Programmer	Jupiter

Suppose, you have been asked to decompose the given relation into two smaller relations such as EmpRole (empName, role) and RoleProject (role, projName).

Determine what type of decomposition this is. Justify your answer in the context of the given relation.

3. Let T_1, T_2 and T_3 be transactions that operate on the same database items A, B, and C. Let $r_1(A)$ mean that T_1 reads A, $w_1(A)$ mean that T_1 writes A, and so on for T_2 and T_3. [24]

Consider the following schedules S_0, S_1 and S_2.
S_0: $r_1(A)$; $r_2(A)$; $w_1(A)$; $r_3(A)$; $w_3(A)$; $w_2(A)$
S_1: $r_1(A)$; $r_1(B)$; $r_2(A)$; $r_3(B)$; $r_3(C)$; $w_2(A)$; $w_2(B)$; $w_3(C)$
S_2: $r_1(A)$; $r_3(C)$; $r_2(C)$; $w_3(A)$; $r_2(B)$; $r_3(B)$; $w_2(B)$; $w_2(A)$

If the last digit of your id is **odd** you will answer the following questions for S_0 and S_1. Otherwise, you will answer the following questions for S_0 and S_2 (**even**).

a) **Determine** whether the given schedules are serializable or not. If a schedule is serializable, give an equivalent serial schedule. (16 marks)

b) **Rewrite** the two schedules by putting commit statements appropriately so that both are recoverable and cascadeless schedules. The instruction $commit_1$ indicates that transaction T_1 has committed. (8 marks)

4. Assume the following transactions are to be performed. [12]

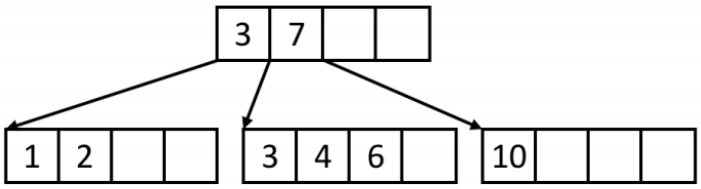
Transaction T_1	Transaction T_2
1. read(a) 2. a = a + 10 3. write(a) 4. read(b) 5. b = b × 5 6. write(b)	1. read(a) 2. a = a × 2 3. write(a)

a) If the initial value of a is (last digit of your student id + 1) and the initial value of b is (last digit of your student id + 1) × 2. What are their final values if we perform the transactions serially using the order T_1 and then T_2? (6 marks)

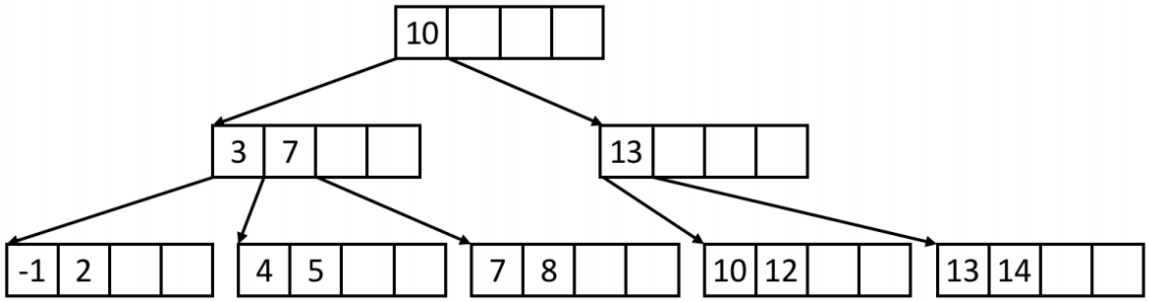
b) **Write** a concurrent schedule for transactions T1 and T2 as mentioned above that illustrates the lost update problem. (6 marks)

5. **Determine** which of the trees are valid B+ Trees. Justify your answer. [10]

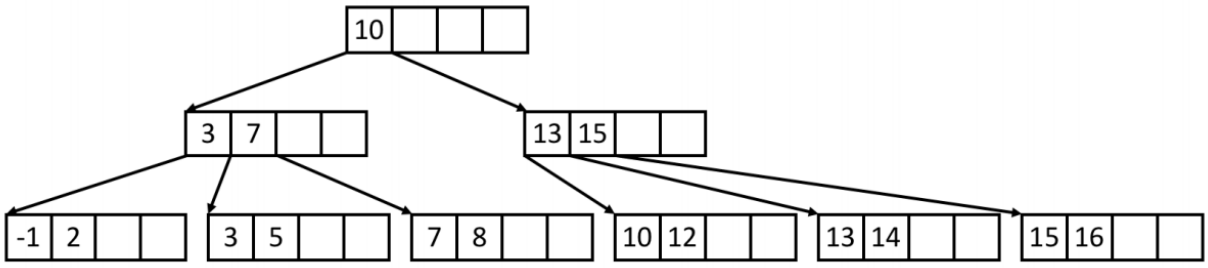
a)



b)



c)



6. Suppose, you have an initially empty B+ tree of order n = 2. [20]

The following keys will be inserted one after another into the B+ Tree.

(last digit of your student id), 3, 9, 8, 7, 2, 1, 5, 10

Draw the resulting B+ Tree after each insertion.