Nirma University

Institute of Technology

Semester End Examination (IR/RPR), December - 2019

M. Tech. in Computer Science and Engineering, Semester-I /

M. Tech. in Computer Science and Engineering (Data Science), Semester-I

3CS1112 Advanced Database Systems

Roll/Exam No | | Supervisor's initial with date | |

Time: 3 Hours | Max. Marks: 100

Instructions:
1. Attempt all questions.
2. Figures to the right indicate full marks.
3. Draw neat sketches wherever necessary.
4. Assume necessary data wherever required.

Section I

Q.1 Answer the following

A. Consider the following schema: **18**

CO2, BL3 **6**

Guitars (gid, brand, price), Players (pid, name, age),

LastPlayed (gid, pid, date)

Query:

```
SELECT P.name
FROM Guitars G, Players P, LastPlayed L
WHERE G.gid = L.gid AND P.pid = L.pid
AND P.age < 25 AND G.brand = 'Gibson'
AND G.price > 3000;
```

Data distribution:

Players.age ranges from 10 to 85, Guitars.brand has 10 distinct values, Guitars.price ranges from 1,000 to 5,000, Guitars.gid has 1,000 distinct values, Players.pid has 1,000 distinct values.

Compute the selectivity for age, brand and price terms in the WHERE clause.

B. Suppose B(R)=10,000 T(R)=500,000. Let there be an index on R.a, and let V(R,a)=k for some number k. Give the cost of $\sigma_{a=0}(R)$, as function of k, under following circumstances. **6**

CO2, BL3

1. index is clustering
2. index is not clustering
3. R is clustered and index is not used

C. Show how MongoDB organizes data for operational purpose. **6**
CO3, BL2

Q.2 Do as directed **18**

A. Suppose a database has the following schema: **6**
CO2, BL3 Trip(fromAddrId: INTEGER, toAddrId: INTEGER, date: DATE)
Address(id: INTEGER, street: STRING, townState: STRING)

1. Write a SQL query that returns the street of all addresses having townState as 'Stony Brook NY' that are destination of a trip on '5/14/02'.

2. Translate the SQL query in into the corresponding relational algebra expression.

3. Translate the relational algebra expression into an equivalent query tree using pushing of selections and projections.

B. How does multi-pass sort based algorithm to compute natural join **8**
CO2, BL4 behave differently than one-pass sort based algorithm? What are overheads of multi-pass sort based algorithm? Demonstrate with suitable example.

OR

B. Demonstrate Duplicate elimination with two pass sorting algorithm. **8**
CO2, BL4 Main memory has blocks 4 and in each block 2 tuples can be adjusted. Relation R has 19 tuples as 2,5,2,1,2,2,4,5,4,3,4,2,1,5,2,1,6,5,4.

C. Encode following bitmaps using Run Length Encoding: **4**
CO1, BL3 1) 01100000001000000100
2) 10000010000001001101

Q.3 Answer the following **14**

A. Produce a wait-for graph for the following transaction scenario and **4**
CO3, BL4 determine whether a deadlock exists.

Transaction	Data items locked	Data items waiting for
T1	x2	x1,x3
T2	x3, x10	x7, x8
T3	x8	x4, x5
T4	x7	x1
T5	x1, x5	x3
T6	x4, x9	x6
T7	x6	x5

B. CO1, BL3 Suppose we store a relation R(x,y) in a grid file. Both attributes have a range of values from 0 to 1000. The partitions of this grid file happen to be uniformly spaced; for x there are partitions every 20 units, at 20, 40, 60, and so on, while for y the partitions are every 50 units, at 50, 100, 150, and so on. How many buckets do we have to examine to answer the range query? **6**

SELECT * FROM R

WHERE 310 < x AND x < 400 AND 520 < y AND y < 730

OR

B. CO1, BL3 Compare the multi-dimensional indexing methods, Grid Files and Partitioned Hashing. **6**

C. CO2, BL3 Consider the following query **4**

Select * from emp, dept, acnt

where emp.dno=dept.dno and dept.ano=acnt.ano

Show the three possible join trees that can be used to combine the emp, dept, and acnt relations to answer the query.

Section II

Q.4 Answer the following **18**

A. CO1, BL3 Compare the k-d Tree and Quad tree index structures. **4**

B. CO1, BL2 With suitable example compare BTree and B+Tree in terms of space usage and its organization. **6**

C. CO3, BL3 Which transactions need to be rolled back, if sequence of actions given below is followed by an abort of transaction T1? **4**

r1(A); r2 (B); W1(B); w2 (C); r3(B); r3 (C); w3 (D)

D. CO1, BL3 Consider a hash table with buckets that can hold a maximum of 2 records. The hash table is initially empty and we insert records with the following hash keys: **4**

100, 001, 000, 001, 111

Hash table is an extendible hash table. Draw the hash table after all insertions.

Q.5 Do as directed

A. With an example demonstrate the concept of primary index and secondary index. — CO2, BL3 — **4**

B. With help of precedence graph, check whether following schedule is serializable? If yes, specify equivalent serial schedule. — CO3, BL4 — **6**

$r_1(A); r_2(A); r_3(B); w_1(A); r_2(C); r_2(B); w_2(B); w_1(C);$

OR

B. Suppose there is index on R.a attribute. Describe how does index improve execution of R ∪ S, where R and S does not have any duplicates. — CO3, BL4 — **6**

C. If B(S) = B(R) = 20,000 and M = 2000, what is the number of disk I/Os required for a hybrid hash join? — CO2, BL3 — **4**

Q.6 Answer the following

A. Consider below mentioned sequence of log records representing the actions of transaction T : — CO3, BL4 — **6**

<start T> ; < T, A,10> ; < T,B,20> ; <commit T>;

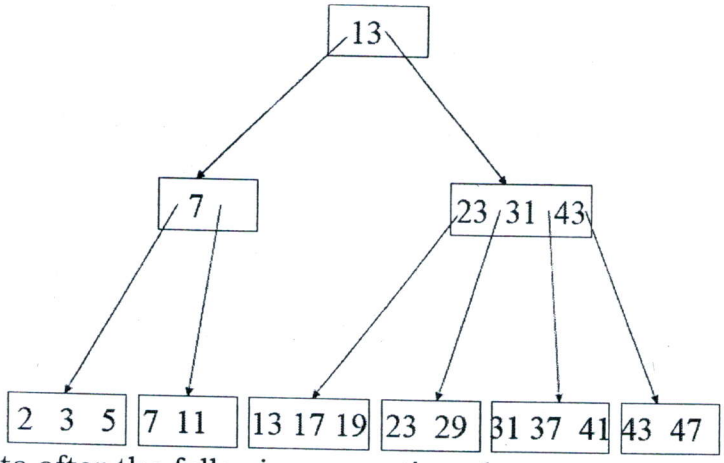
Consider A is updated as 5, and B is updated as 24. Specify all the sequences of event that are legal according to the rules of undo logging, where the events of interest are writing to disk the blocks containing database elements, and the blocks of the log containing the update and commit records.

B. With suitable example show why log records for transactions on the undo-list must be processed in reverse order, whereas redo is performed in a forward direction. — CO3, BL2 — **6**

OR

B. Compare conventional checkpointing with nonquiescent checkpointing with example. — CO3, BL2 — **6**

C. Consider the following B+ tree with n=3, here n represents number of maximum key values allowed in the node. — CO1, BL3 — **6**



Show its state after the following operations happen:

1. Insert a record with key 1
2. Insert records with keys 14 through 16. Show the splits that will happen and the final state after 14, 15, and 16 are inserted.
3. Delete the record with key 23.