Wednesday, 3 December 2025 2:08 PM

Q1

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International Institute of Information Technology, Hyderabad
(Deemed University)
Data Systems – Monsoon 2025
Mid Semester Examination
End Semester Examination

Max. Time: 2 Hr		**Max. Marks: 100**	
Name:	**Programme:**	**Date of Exam:**	
Roll no:	**Date/Time:**	**Instructor:**	**Signature:**

Instructions: Read carefully, read slowly, read twice, write legibly, write neatly, write concisely.

1. Do not turn the page to Part A and Part B, but read carefully the entire paper first. **Part A is for you answer both, only Part B will be considered for grading.**
2. **Answer the questions in Part A in the designated pages. If, and, only if, Part B, answer on pages a and b. Answer outside or other pages will not be graded.**
3. Do not write anything except your roll number in the margins.

Marks Table for Marks Secured by Examiner:

Question No.	Maximum Marks	Marks Secured
Part A	50	
Part B	40	
OR		
Part B	100	
Total	100	

General Instructions to the Student

1. Place your Permanent Student Card (PSC) on the desk during the examination for verification by the invigilator.
2. Mobile phones, smartwatches, or any other electronic devices are not allowed under the examination hall.
3. Do not bring anything material or calculators from other students to the examination hall is prohibited.
4. If any malpractice/misbehavior/misconduct or cheating in the examination hall, the student will be given 0 grade in the course, and will be reported to the Institute for further action.

Wish of Luck

No Clarifications during the exam (if required, make justifiable assumptions). Read all instructions and questions carefully before proceeding.

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Rough Work

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Part A (Learning of the Present)

1. Consider the relation **Parent (key, age, child)** given below. The domain of attribute **key** is integer, **age** is integer, and **child** is boolean. Assume that key that refers to another parent's key, be partial nulls, are given to this question (except sub-questions 4 and 5). **Either you get 0 correct with full marks or zero.**

Parent		
key	age	child
1	40	T
1	42	T
2	50	T
2	52	T
3	60	T
3	62	T
4	70	T
4	72	T

We states the following assumptions:

a) Key is the primary key of the table Parent.
b) A data block can store upto four tuples (only) for any relation.
c) A data block can store only one key of any intermediate result.
d) Tuples are stored randomly in the data blocks of the table Parent. Query executes for one or more, in the order of the table Parent as stated below.
e) Two blocks in the main memory assigned to Parent relation, one for tuples, one for intermediate results. Assume that the intermediate results are stored in memory. Do not consider the storage requirements of the query or of results in memory.

Answer the following questions on pages 1 and 2.

a) What is the number of rows and data blocks needed to store relation Parent? [1 Mark]
b) What is $V(Parent, key)$ and $V(Parent, child)$. [1 Mark]
c) What is the estimated number of rows in Parent, R_{Parent}? [1 Mark]
d) What is the estimated number of blocks, B_{Parent}? [1 Mark]
e) What is the number of blocks in Parent, B_{Parent}? [1 Mark]
f) What is the actual number of rows in Parent, R_{Parent}? [1 Mark]
g) What is the actual number of blocks, B_{Parent}? [1 Mark]

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Question 2 (Learning of the Present)

2. Consider the following **Parent** (key, age, child) relation (as stated in Question 1). Assume that the table Parent is stored in a file, and the query executes top, that refers to another parent's key, be partial nulls, are given to this question (except sub-questions 4 and 5). **Either you get 0 correct with full marks or zero.**

We state the following assumptions:

a) Key is the primary key of the table Parent.
b) A data block can store upto four tuples (only) for any relation.
c) A data block can store only one key of any intermediate result.
d) Tuples are stored randomly in the data blocks of the table Parent. Query executes for one or more, in the order of the table Parent as stated below.
e) Two blocks in the main memory assigned to Parent relation, one for tuples, one for intermediate results. Assume that the intermediate results are stored in memory. Do not consider the storage requirements of the query or of results in memory.

Answer the following questions on pages 1 and 2.

a) What is the number of rows and data blocks needed to store relation Parent? [1 Mark]
b) What is $V(Parent, key)$ and $V(Parent, child)$. [1 Mark]
c) What is the estimated number of rows in Parent, R_{Parent}? [1 Mark]
d) What is the estimated number of blocks, B_{Parent}? [1 Mark]
e) What is the number of blocks in Parent, B_{Parent}? [1 Mark]
f) What is the actual number of rows in Parent, R_{Parent}? [1 Mark]
g) What is the actual number of blocks, B_{Parent}? [1 Mark]

No Clarifications during the exam (if required, make justifiable assumptions). Read all instructions and questions carefully before proceeding.

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Question 3 (Query Cost)

3. Consider the following query (cost is not important) to find the average age of all great-grandparents. A great-grandparent is the parent of a grandparent [1 Mark].

a) What is the result of this query when executed on the above relation? [1 Mark]

b) What is the optimal query execution plan for this query? [4 Marks – parse-tree given]

c) Execute the above optimal query execution plan to determine the total number of block accesses required to execute the query. [5 Marks – parse-tree given]

d. Consider the following schedule (original order of S, and r and s, S, and t, respectively). **There are no partial reads for this question** (write your answers on pages 5).

R(S), W(S=S), R(S), W(S=S), R(S), W(S=S), R(S), R(S), R(S), R(S), W(S=S), R(S), W(S=S).

a. What type of a schedule is S? [1 Mark].

b) Can you come up with a serializable schedule for these transactions? [1 Mark].

c) Put concrete and alarm to make this schedule not recoverable? [1 Mark].

d) Put concrete and alarm to make this schedule cascade aborts problems [1 Mark].

e) Give a schedule of the above transactions that cause the lost update problem. [1 Mark].

f) Assume that all active are immediately flushed to disk and all commits are after flush. What will the recovery algorithm do at restart if the system crashes after the last operation in the schedule taken and their impact (changes made to A, B, C)? [1 Mark].

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Rough Work

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Part A – Question 3 Answers

Question (briefly)	Answer (only the final answer)
a number of rows and data blocks	16, 4 blocks
b What are $V(Parent, key)$ and $V(Parent, child)$	16, 2
c The estimated number of rows in Parent, R_{Parent} = 16/2	16
d Estimated number of rows in Parent, B_{Parent} = 16/4	4
e Number of blocks in Parent, B_{Parent}	4
f Actual number of rows in Parent, R_{Parent}	16
g Actual number of blocks in Parent, B_{Parent}	4

No Clarifications during the exam (if required, make justifiable assumptions). Read all instructions and questions carefully before proceeding.

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Part A – Question 3 Answers

a) optimal query execution plan (give the final query execution plan below) (no details on how you get it, just state in the rough right)

b) Total number of blocks access are needed to execute the query.

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Part A – Question 3 Answers

Question	Answer
c) Put concrete and alarm to make this schedule not recoverable	Concrete
d) Concrete and alarm to make this schedule cascade aborts problems	R(S) R(S) R(S)