

NATIONAL UNIVERSITY OF SINGAPORE

CS3223 - DATABASE SYSTEM IMPLEMENTATION (SAMPLE ASSESSMENT)

(Semester 2: AY2022/23)

Time Allowed: 100 minutes

INSTRUCTIONS TO STUDENTS

1. Write down your **student number** on the right and using ink or pencil, shade the corresponding circle in the grid for each digit or letter. **DO NOT WRITE YOUR NAME!**
2. The assessment paper contains **THREE (3) questions** and comprises **FIVE (5) pages** including this cover page.
3. All questions must be answered in the space provided; no extra sheets will be accepted as answers. You may use the extra page behind this cover page if you need more space for your answers.
4. This is a **closed book** assessment.
5. You are allowed to refer to a single, double-sided A4-sized sheet of notes.
6. You are allowed to use an electronic calculator.
7. You are allowed to use pencils, ball-pens or fountain pens, as you like as long as it is legible (no red color, please).
8. **Marks may be deducted** for illegible handwriting

STUDENT NUMBER								
A								
U ○	0	0	0	0	0	0	0	(A) (N)
A ●	1	1	1	1	1	1	1	(B) (R)
HT ○	2	2	2	2	2	2	2	(E) (U)
NT ○	3	3	3	3	3	3	3	(H) (W)
	4	4	4	4	4	4	4	(J) (X)
	5	5	5	5	5	5	5	(L) (Y)
	6	6	6	6	6	6	6	(M)
	7	7	7	7	7	7	7	
	8	8	8	8	8	8	8	
	9	9	9	9	9	9	9	

For Examiner's Use Only

Question	Marks
Q1	/ 2
Q2	/ 2
Q3	/ 6
Total	/ 10

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Use it ONLY if you need extra space for your answers, in which case indicate the **question number clearly** on this page as well as in the original answer box.

Question 1: Linear Hashing Index [2 marks]

Consider the snapshot of the linear hashing index shown below.

level = 0, $N_0 = 4$, next=0

00

64*	44*		
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01

9*	25*	5*	
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10

10*			
-----	--	--	--

11

31*	15*	7*	3*
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Assume that a bucket split is triggered whenever some bucket overflows.

Let N denote the minimum number of record insertions that will cause a split of all four buckets.

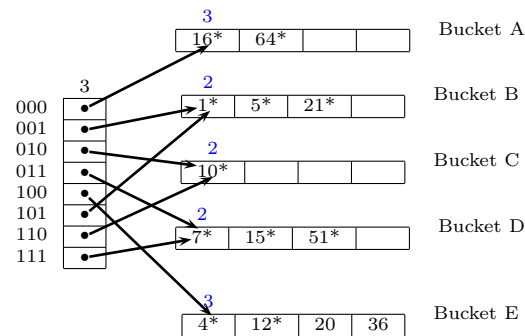
Select the **most appropriate** statement about N .

[2 marks]

- ☐ $N = 5$
- ☐ $N = 6$
- ☒ $N = 7$
- ☐ $N = 8$
- ☐ $N = 9$
- ☐ All of the above statements are false.

Question 2: Extendible Hashing [2 marks]

Consider the extendible hashing index shown below which was created by inserting a sequence of 13 data entries without any deletions.



Select **all** the statements that are true about the above index.

[2 marks]

- ☒ Bucket A could be the last bucket that was split by the insertions.
- ☒ Bucket B could be the last bucket that was split by the insertions.
- ☐ Bucket C could be the last bucket that was split by the insertions.
- ☐ Bucket D could be the last bucket that was split by the insertions.
- ☐ Bucket E could be the last bucket that was split by the insertions.
- ☐ All of the above statements are false.

Question 3: Query Evaluation [6 marks]

Consider a relation with the schema **Hotel** (id, name, address, phone, price, rating) and the following query

SELECT name FROM Hotel WHERE price > 500 AND rating > 4

Assume the following for this question:

1. The **Hotel** relation contains 10,000 pages with each page containing 20 records.
2. There are five unclustered indexes on the **Hotel** relation:
 - I_p : a B⁺-tree index on (price),
 - I_r : a B⁺-tree index on (rating),
 - I_{pr} : a B⁺-tree index on (price, rating),
 - I_{rp} : a B⁺-tree index on (rating, price), and
 - I_{npr} : a B⁺-tree index on (name, price, rating).
3. For each of I_p and I_r , it has 2000 leaf pages with at most 100 data entries in each leaf page.
4. For each of I_{pr} and I_{rp} , it has 2500 leaf pages with at most 80 data entries in each leaf page.
5. For I_{npr} , it has 4000 leaf pages with at most 50 data entries in each leaf page.
6. Each of the indexes has 2 levels of internal nodes.
7. Only 10% of **Hotel** records satisfy the condition “price > 500”.
8. Only 20% of **Hotel** records satisfy the condition “rating > 4”.
9. Only 1% of **Hotel** records satisfy both the conditions “price > 500” and “rating > 4”.

What is the best evaluation plan for the query? What is its cost?

[6 marks]

— E N D O F P A P E R —