



# United International University

Department of Computer Science and Engineering

CSI 221 – Database Management Systems, Term Final Exam, Spring 2021

Total Marks: 40, Time: 1 hour 30 minutes

Answer all the questions

1.

- a) Suppose your database stores 10 data records in the following order where each data block can contain at most 2 data records: [5]

(2021-01-03, 1, def)  
(2021-01-14, 5, mno)  
(2021-01-19, 13, uvw)  
(2021-01-24, 1, jkl)  
(2021-02-01, 24, pqr)  
(2021-02-16, 4, xyz)  
(2021-03-07, 7, ghi)  
(2021-03-25, 5, abc)  
(2021-04-13, 4, vwx)  
(2021-04-29, 13, stu)

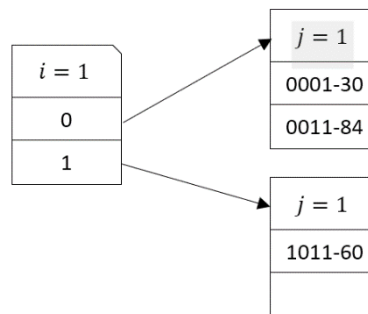
By using this database and data records, design the following index structures:

- i) Draw a *secondary dense* index structure based on the 2nd column data.  
ii) Draw a *secondary sparse* index structure based on the 3rd column data.

Assume each index block can contain at most 4 index records.

- b) Consider the following Extensible Hash index structure with 2 keys/bucket and the hash function is:

$$h(k) = (3k + 23) \bmod 16$$



Now insert 51 within this hash structure. You must explain and demonstrate each step clearly. [8]

2.

- a) Consider the following *Book*, *Writer* and *Publisher* tables: [3+4]

Book					
Id	Title	WriterId	PublisherId	PublishYear	Price
1	Debi	1	2	1985	150
2	Agnibina	2	4	1922	90
3	Ami Topu	3	3	2005	200
4	Deyal	1	1	2013	450
5	Dipu Number Two	3	3	1984	150
6	Mrityukhudha	2	2	1930	160

Writer	
Id	Name
1	Humayun Ahmed
2	Kazi Nazrul Islam
3	Muhammed Zafar Iqbal
4	Rokib Hasan

Publisher		
Id	Name	Rating
1	Anyaparakash	4.7
2	Abosar	4.5
3	Somoy	4.4
4	Mowla Brothers	4.6

Answer the following questions:

- Write a query in relational algebra to show the book title, publisher name and price of the books with price within the range 200 to 300, publishing year before 1950 and publisher rating greater than 4.5
- Write output for the following relational algebra expression: [show each steps clearly]

$$\text{Name, PublishYear} \bowtie \mathcal{G}_{\text{sum(Price)}} (\sigma_{\text{PublishYear} \% 2 = 0} (\text{Book} \bowtie \text{Writer})) \cup \\ \text{Name, PublishYear} \bowtie \mathcal{G}_{\text{sum(Price)}} (\sigma_{\text{PublishYear} \% 2 = 1} (\text{Book} \bowtie \text{Writer}))$$

- Consider the following schedule of 6 transactions and detect all the conflicted instruction pairs that will cause database inconsistency:

[5]

T <sub>1</sub>	T <sub>2</sub>	T <sub>3</sub>	T <sub>4</sub>	T <sub>5</sub>	T <sub>6</sub>
Read(A)					
		Read(B)			
	Write(C)				
					Write(B)
		Read(D)			
				Read(A)	
Write(A)					
	Read(B)				
			Write(C)		
			Write(D)		
				Read(B)	
Read(C)					
					Read(A)
		Write(D)			
					Read(C)
Read(D)					
				Write(B)	
	Read(C)				

3.

- Consider the following Relation  $R$  and set of Functional dependencies  $F$ :

[1+5+2]

$$R = (A, B, C, D, E, F)$$

$$F = \{B \rightarrow F, A \rightarrow E, CD \rightarrow AB, BE \rightarrow CF\}$$

- Find out the attribute closure of  $DC$ .
- Determine all the candidate keys of the relation  $R$ .
- Check the  $3NF$  form for the given relation  $R$ .

- Consider the following Relation  $R_1$  and set of Functional dependencies  $F_1$ :

[4+3]

$$R_1 = (A, B, C, D, E, F)$$

$$F_1 = \{A \rightarrow B, C \rightarrow E, F \rightarrow D, ABC \rightarrow F, BCE \rightarrow D, BCF \rightarrow D, BE \rightarrow D\}$$

- Remove all the extraneous attributes from  $F_1$
- Remove all the extraneous functional dependencies from  $F_1$