

CS4224/CS5424 Quiz 1: Distributed Database Design

1. Consider a database stored in a cluster of 5 nodes (A,B,C,D, and E) using Consistent Hashing with the following hashed values assigned to the nodes: $h(A) = 50$, $h(B) = 30$, $h(C) = 70$, $h(D) = 10$, and $h(E) = 90$. Assume that the database records are partitioned based on the hashed values of the key attribute k given by $h(k)$.

Identify the node for storing each of the following record insertions with key k : (1) $h(k) = 55$, (2) $h(k) = 100$, and (3) $h(k) = 58$.

Solution: (1) C. (2) D. (3) C.

2. Consider the relation **Employee** (eid, name, age, department, title) where $\text{Domain}(\text{department}) = \{\text{"IT"}, \text{"Sales"}\}$.
- (a) Compute the minterm predicate partitioning F_a of *Employee* wrt the set of queries $S_a = \{Q_1, Q_2, Q_3, Q_4\}$, where each $Q_i = \sigma_{p_i}(\text{Employee})$ and
- $p_1 = (\text{age} \leq 30)$
 - $p_2 = (\text{age} \leq 60)$
 - $p_3 = (\text{department} = \text{"IT"})$
 - $p_4 = (\text{department} = \text{"Sales"})$
- (b) Compute the minterm predicate partitioning F_b of *Employee* wrt the set of queries $S_b = \{Q_5, Q_6\}$, where each $Q_i = \sigma_{p_i}(\text{Employee})$ and
- $p_5 = (\text{age} \leq 30) \wedge (\text{department} = \text{"IT"})$
 - $p_6 = (\text{age} \leq 60) \wedge (\text{department} = \text{"Sales"})$
- (c) For each of the following statements, state whether it is *true* or *false*:
- F_a is a complete partitioning wrt Q_5 .
 - F_a is a complete partitioning wrt Q_6 .
 - F_b is a complete partitioning wrt Q_1 .
 - F_b is a complete partitioning wrt Q_2 .
 - F_b is a complete partitioning wrt Q_3 .
 - F_b is a complete partitioning wrt Q_4 .

Solution:

- (a) $P = \{p_1, p_2, p_3, p_4\}$. $MTPred(P) = \{m_1, m_2, m_5, m_6, m_{13}, m_{14}\}$, where

- $m_1 = \text{age} > 60 \wedge \text{department} = \text{"Sales"}$
- $m_2 = \text{age} > 60 \wedge \text{department} = \text{"IT"}$
- $m_5 = \text{age} > 30 \wedge \text{age} \leq 60 \wedge \text{department} = \text{"Sales"}$
- $m_6 = \text{age} > 30 \wedge \text{age} \leq 60 \wedge \text{department} = \text{"IT"}$
- $m_{13} = \text{age} \leq 30 \wedge \text{department} = \text{"Sales"}$
- $m_{14} = \text{age} \leq 30 \wedge \text{department} = \text{"IT"}$

- (b) $P = \{p_5, p_6\}$. $MTPred(P) = \{m_0, m_1, m_2\}$, where

- $m_0 = (\text{age} > 60) \vee (\text{department} = \text{"IT"} \wedge \text{age} > 30)$
- $m_1 = \text{age} \leq 60 \wedge \text{department} = \text{"Sales"}$
- $m_2 = \text{age} \leq 30 \wedge \text{department} = \text{"IT"}$

- (c) i. F_a is a complete partitioning wrt Q_5 . True.
ii. F_a is a complete partitioning wrt Q_6 . True.

- iii. F_b is a complete partitioning wrt Q_1 . False.
- iv. F_b is a complete partitioning wrt Q_2 . False.
- v. F_b is a complete partitioning wrt Q_3 . False.
- vi. F_b is a complete partitioning wrt Q_4 . False.

3. Consider the relations R , S , T , and U , where $\{R_1, R_2\}$, $\{S_1, S_2\}$, and $\{T_1, T_2\}$, are respectively, the horizontal fragmentations of relations R , S , and T .

- (a) Compute the derived horizontal fragmentation of relation U wrt the fragmentation of R .
- (b) Compute the derived horizontal fragmentation of relation U wrt the fragmentation of S .
- (c) Compute the derived horizontal fragmentation of relation U wrt the fragmentation of T .
- (d) Which of these derived horizontal fragmentations are complete partitionings?
- (e) Which of these derived horizontal fragmentations are disjoint partitionings?

R_1	S_1	T_1	U																								
<table><tr><th>X</th><th>B</th></tr><tr><td>5</td><td>80</td></tr><tr><td>10</td><td>55</td></tr><tr><td>11</td><td>25</td></tr></table>	X	B		5	80	10	55	11	25	<table><tr><th>Y</th><th>C</th></tr><tr><td>20</td><td>6</td></tr><tr><td>13</td><td>8</td></tr><tr><td>10</td><td>2</td></tr></table>	Y	C	20	6	13	8	10	2	<table><tr><th>Z</th><th>A</th></tr><tr><td>83</td><td>187</td></tr><tr><td>8</td><td>140</td></tr><tr><td>9</td><td>100</td></tr></table>	Z	A	83	187	8	140	9	100
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Solution:

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- (e) (b) and (c)