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Q.1) Soln. 2)

Given $B(R) = B(S) = 10000$, $M = 1000$

→ For a nested loop join, $M \geq 2$ blocks will be required as $M = 1000$, it will be sufficient.
The records of S will be filled in $(M-1)$ blocks of main memory.

→ This will require $\frac{B(S)}{(M-1)}$ iterations of the outer loop. In each such iteration, we read $(M-1)$ blocks of S and $B(R)$ blocks of R.

→ The no. of disk input/output is $\frac{B(S)}{M-1}(M-1 + B(R))$

$$= B(S)\left[1 + \frac{B(R)}{M-1}\right]$$

→ No. of blocks in S and R are 10000, $M = 1000$.

$\Rightarrow$ No of disk I/O's $= B(S) + \frac{B(R)B(S)}{M-1}$

$$= 10000 + \frac{10000 \times 10000}{(1000-1)}$$

$$= 110100.1$$

Hence, the no. of disk I/O's req^n = 110101 Ans

Qs. 2)

Soln (2), (3) : $B(R) = B(S)$, $M = 1000$

$= 10000$

Set Union: Two pass algorithm.

→ In case of a set union, each tuple of R and S is read twice into main memory, once when the sublists are created and once as part of one of the sublists. The tuples are also written to the disk once.

Therefore, the cost in disk I/O's is

$$3(B(R) + B(S))$$

Net Cost $= 3(B(R) + B(S)) = 6 \times B(R) = 60000$.

⇒ The algorithm will work only if the total no. of sublists does not exceed M. This says that the sizes of the relation must not exceed M^2.

$$\Rightarrow \boxed{B(R) + B(S) \leq M^2}$$

$B(R) + B(S) = 20000$

and $M = 1000 \Rightarrow M^2 = 1000000$

$$\Rightarrow \boxed{B(R) + B(S) < M^2}$$

Hence, the algorithm is feasible.

⇒ The disk requirement is that 60,000 I/O's operations will take place.

Qs. 2) (d) $B(R) = B(S) = 10000$, $M = 1000$

Simple sort-join: two-pass algorithm based on sorting.

→ To sort R and S, we use $4(B(R) + B(S))$ disk I/o operations.
To merge the sorted R and S to get the joined tuples, we read all blocks of R and S for a fifth time.

⇒ Hence, the simple sort join, uses in total $5(B(R) + B(S))$ disk I/o operations.

Cost $= 5(B(R) + B(S)) = 10 * B(R) = 100000$

∴ The memory available $= M = 1000$ blocks.
As we need to perform two-phase, multi-way merge sort on R and S, we need $B(R) \leq M^2$, $B(S) \leq M^2$ to perform the above sorts.
∴ $M^2 = (1000)^2 = 1000000 \geq B(R)$
and $M^2 = 1000000 \geq B(S)$
Thus, we can see that $\boxed{B(R) = B(S) \leq M^2}$
⇒ Hence, the algorithm is feasible.

The req^r no. of disk I/o's operations = $\boxed{100000}$ // Ans.

Q.5) Soln (5).

A) Size of $(W \bowtie X)$ is:

$\therefore$ b is common attr.

$$= T(W)\,T(X) / \max \text{ of } \{V(X,b), V(X,b)\}$$

$$= \frac{2\times10^4}{60} \rightarrow (i)$$

B) Size of $(W \bowtie X) \bowtie Y \Rightarrow$

$\therefore V(W \bowtie X, C) = V(X,C)$ (as C is non-join attr)

$$\Rightarrow \frac{T(W \bowtie X)\,T(Y)}{\max[V(W \bowtie X, C), V(Y,C)]}$$

$$= \frac{2\times10^4}{60} \times \frac{300}{\max(100,50)} = \frac{2\times10^4 \times 5}{50\times 2}$$

$$= 1000 \rightarrow (ii)$$

c) Size of $((W \bowtie X) \bowtie Y) \bowtie Z =$

$\therefore V((W \bowtie X) \bowtie Y, d) = V(Y,d)$ as d is non join attr.

$$= \frac{T((W \bowtie X) \bowtie Y)\,T(Z)}{\max\{V(Y,d), V(Z,d)\}} = \frac{1000 \times 400}{50}$$

$$= 8000 \text{ tuples}$$

Since,

$W \bowtie X \bowtie Y \bowtie Z = (((W \bowtie X) \bowtie Y) \bowtie Z)$

$= 8000$ tuples.

* Hence, size of $N \bowtie X \bowtie Y \bowtie Z = 8000$ Ans.