Query Processing and Optimization

Other optimization issues

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Heuristics in Query Optimization

HEURISTIC OPTIMIZATION

• Mapping queries into alternative algebraic forms for more efficient execution
Heuristics in Query Optimization

- Heuristic rules to modify the internal representation of a query, (usually expressed in the form of the tree or graph) to improve its expected performance.

- One of the main Heuristic Rules is to apply SELECT and PROJECT operations before applying the join or other binary operations.
Query Trees and Query Graphs

- A query tree is a data structure that corresponds to a relational algebra expression.
- The input relations of the query are represented as leaf nodes of the tree.
- The relational algebra operations are represented as internal nodes.
Transformation Rules for Relational Algebra Operations.

1. Cascade of $\sigma$:

A conjunctive selection condition can be broken up into a cascade (sequence) of individual $\sigma$ operations:

$$\sigma c_1 \text{ AND } c_2 \text{ AND } \ldots \text{ AND } c_n(R) = \sigma c_1 (\sigma c_2 (\ldots (\sigma c_n(R)) \ldots ))$$
Transformation Rules for Relational Algebra Operations.

2. Commutativity of $\sigma$:

The $\sigma$ operation is commutative:

$$\sigma c_1 (\sigma c_2 (R)) = \sigma c_2 (\sigma c_1 (R))$$
Transformation Rules for Relational Algebra Operations.

3. Cascade of $\pi$:

In a cascade (sequence) of project operations, all but the last one can be ignored:

$$\pi_{\text{List}_1} (\pi_{\text{List}_2} (\ldots (\pi_{\text{List}_n}(R))\ldots) ) = \pi \text{ List}_1(R)$$
Transformation Rules for Relational Algebra Operations.

4. Commuting $\sigma$ with $\pi$:

If the selection condition $c$ involves only the attributes $A_1, ..., A_n$ in the projection list, the two operations can be commuted:

$$\pi_{A_1, A_2, ..., A_n} (\sigma_c (R)) = \sigma_c (\pi_{A_1, A_2, ..., A_n} (R))$$
Transformation Rules for Relational Algebra Operations.

5. Commutativity of JOIN:

The JOIN operation is commutative:

\[ R \text{ JOIN}_c S = S \text{ JOIN}_c R \]

Notice that, although the order of attributes may not be the same in the relations resulting from the two joins, the “meaning” is the same because order of attributes is not important in the alternative definition of relation that we use here.
Transformation Rules for Relational Algebra Operations.

6. Commuting $\sigma$ with \textit{JOIN}:

- If all the attributes in the selection condition $c$ involve only the attributes of one of the relations being joined say, $R$, the two operations can be commuted as follows:
  
  $$\sigma c \left( R \JOIN S \right) = \left( \sigma c \left( R \right) \right) \JOIN S$$
Transformation Rules for Relational Algebra Operations.

- Transformation 7 To 12 (See text book).