Lecture 26: Cost-based Optimization

Monday, November 27, 2000

Outline

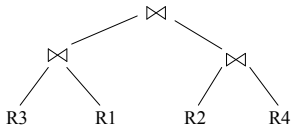
- Choosing an order for Joins (7.6)

Unit of Optimization

- Select-project-join
- Push selections down, pull projections up
- Hence: we need to choose the join order
- This is the main focus of an optimizer

Join Trees

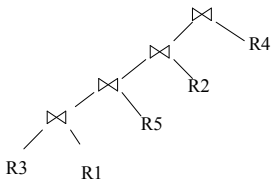
- R1 ⋈ R2 ⋈ …. ⋈ Rn
- Join tree:



- A join tree represents a plan. An optimizer needs to inspect many (all ?) join trees

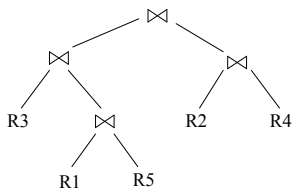
Types of Join Trees

- Left deep:



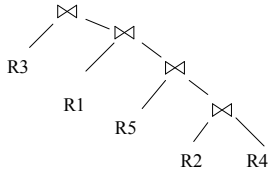
Types of Join Trees

- Bushy:



Types of Join Trees

- Right deep:



Problem

- Given: a query R1⋈ R2⋈ … ⋈ Rn
- Assume we have a function cost() that gives us the cost of every join tree
- Find the best join tree for the query

Dynamic Programming

- Idea: for each subset of {R1, …, Rn}, compute the best plan for that subset
- In increasing order of set cardinality:
  - Step 1: for {R1}, {R2}, …, {Rn}
  - Step 2: for {R1,R2}, {R1,R3}, …, {Rn-1, Rn}
  - …
  - Step n: for {R1, …, Rn}
- A subset of {R1, …, Rn} is also called a *subquery*

Dynamic Programming

- For each subquery Q ⊆ {R1, …, Rn} compute the following:
  - Size(Q)
  - A best plan for Q: Plan(Q)
  - The cost of that plan: Cost(Q)

Dynamic Programming

- Step 1: For each {Ri} do:
  - Size({Ri}) = B(Ri)
  - Plan({Ri}) = Ri
  - Cost({Ri}) = (cost of scanning Ri)

Dynamic Programming

- Step i: For each Q ⊆ {R1, …, Rn} of cardinality i do:
  - Compute Size(Q) (later…)
  - For every pair of subqueries Q', Q'' s.t. Q = Q' U Q'' compute cost(Plan(Q') ⋈ Plan(Q''))
  - Cost(Q) = the smallest such cost
  - Plan(Q) = the corresponding plan

Dynamic Programming

- Return Plan({R1, …, Rn})

Dynamic Programming

To illustrate, we will make the following simplifications:

- Cost(P1 ⋈ P2) = Cost(P1) + Cost(P2) + size(intermediate result(s))
- Intermediate results:
  - If P1 = a join, then the size of the intermediate result is size(P1), otherwise the size is 0
  - Similarly for P2
- Cost of a scan = 0

Dynamic Programming

- Example:
- Cost(R5 ⋈ R7) = 0 (no intermediate results)
- Cost((R2 ⋈ R1) ⋈ R7)
  = Cost(R2 ⋈ R1) + Cost(R7) + size(R2 ⋈ R1)
  = size(R2 ⋈ R1)