Non è possibile visualizzare l'immagine.

Chapter 2: Intro to Relational Model

Relational Query Languages

Database System Concepts, 6th Ed.

Relational Query Languages

- Procedural vs .non-procedural, or declarative
- “Pure” languages:
  - Relational algebra → QUERY OPTIMIZATION
  - Tuple relational calculus
  - Domain relational calculus

  SQL CAN BE THOUGHT OF AS THE "COMMERCIAL" VERSION OF TUPLE RELATIONAL CALCULUS
- The above 3 pure languages are equivalent in computing power
- We will concentrate in this chapter on relational algebra
  - Not Turing-machine equivalent
  - It consists of 6 basic operations → THEY ALL OPERATE ON RELATIONS AND PROVIDE A RELATION AS A RESULT

1) SELECTION
2) PROJECTION
3) UNION
4) SET DIFFERENCE
5) CARTESIAN PRODUCT
6) RENAMING

DERIVED OPS: SET INTERSECTION, NATURAL JOIN, DIVISION, ASSIGNMENT

Select operation – selection of rows (tuples)

- Relation r

DEGREE = 4

CARDINALITY = 4

A	B	C	D
α	α	1	7
α	β	5	7
β	β	12	3
β	β	23	10

- $\sigma_{A=B \wedge D>5}(r)$

COMPARISON BETWEEN ATTRIBUTES

CONSTANT VALUE

A	B	C	D
α	α	1	7
β	β	23	10

OBSERVE THAT THE OPERATION MAY REDUCE THE CARDINALITY, NOT THE DEGREE.

Project operation – selection of columns (attributes)

- Relation *r*:

A	B	C
α	10	1
α	20	1
β	30	1
β	40	2

SINCE REL. ALGEBRA OPERATIONS PROVIDE RELATIONS AS THEIR RESULT, WE CAN EASILY COMPOSE OPERATIONS, FOR INSTANCE:

$$\Pi_{A,C}\left(\sigma_{C>1}(R)\right)$$

WHILE SWAPPING Π AND σ PROVIDES HERE THE SAME RESULT, THE TWO QUERIES MIGHT BE DIFFERENT W.R.T. EFFICIENCY

- $\Pi_{A,C}(r)$

LIST OF ATTRIBUTES

A	C
α	1
α	1
β	1
β	2

=

A	C
α	1
β	1
β	2

MAY REDUCE BOTH DEGREE AS WELL AS CARDINALITY (REMEMBER THAT RELATIONS ARE SETS)

Union of two relations

- Relations *r, s:*

r

A	*B*
α	1
α	2
β	1

s

A	*B*
α	2
β	3

TO PERFORM SET OPERATIONS, THE INVOLVED RELATIONS MUST BE COMPATIBLE

RENAMING OPERATION

- r ∪ s:

A	*B*
α	1
α	2
β	1
β	3

Set difference of two relations

- Relations *r*, *s*:

A	B
α	1
α	2
β	1

r

A	B
α	2
β	3

s

- $r - s$:

A	B
α	1
β	1

Set intersection of two relations

- Relation *r, s*:

A	B
α	1
α	2
β	1

r

A	B
α	2
β	3

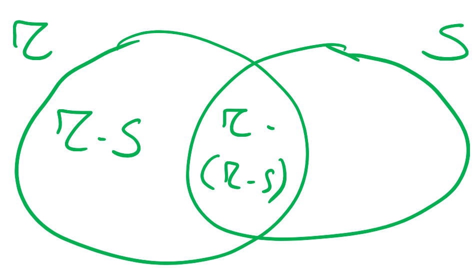
s

NOTE THAT WE DO NOT HAVE SET COMPLEMENTATION; THIS BECAUSE ITS RESULT OF OPERATIONS MUST BE FINITE

- $r \cap s$

A	B
α	2

Note: $r \cap s = r - (r - s)$



Joining two relations – Cartesian product

- Relations *r, s*:

A	B
α	1
β	2

r

C	D	E
α	10	a
β	10	a
β	20	b
γ	10	b

s

- *r* x *s*:

A	B	C	D	E
α	1	α	10	a
α	1	β	10	a
α	1	β	20	b
α	1	γ	10	b
β	2	α	10	a
β	2	β	10	a
β	2	β	20	b
β	2	γ	10	b

NOT SO USEFUL ALONE...
TYPICALLY IT IS FOLLOWED
BY A SELECTION

CARTESIAN PRODUCT + SELECTION = JOIN

Cartesian product – naming issue

- Relations *r*, *s*:

A	B
α	1
β	2

r

B	D	E
α	10	a
β	10	a
β	20	b
γ	10	b

s

- *r* x *s*:

A	r.B	s.B	D	E
α	1	α	10	a
α	1	β	10	a
α	1	β	20	b
α	1	γ	10	b
β	2	α	10	a
β	2	β	10	a
β	2	β	20	b
β	2	γ	10	b

WITH THIS NOTATION WE CAN AVOID DUPLICATE COLUMN NAMES

Renaming

BY MEANS OF THE RENAMING OPERATOR, WE CAN RENAME THE ATTRIBUTES OF A RELATION, AND CHANGE THEIR ORDER :

$$\rho_{B_1, B_2 \ldots B_k \leftarrow A_1, A_2 \ldots A_k} (r)$$

WHERE $r \in R(A_1, A_2, \ldots, A_k)$

Composition of operations

- Can build expressions using multiple operations
- Example: $\sigma_{A=C}(r \times s)$
- *r x s*

A	B	C	D	E
α	1	α	10	a
α	1	β	10	a
α	1	β	20	b
α	1	γ	10	b
β	2	α	10	a
β	2	β	10	a
β	2	β	20	b
β	2	γ	10	b

- $\sigma_{A=C}(r \times s)$

A	B	C	D	E
α	1	α	10	a
β	2	β	10	a
β	2	β	20	b

Joining two relations – Natural Join

- Let r and s be relations on schemas R and S respectively. Then, the "natural join" of relations R and S is a relation on schema $R \cup S$ obtained as follows:
  - Consider each pair of tuples t_r from r and t_s from s.
  - If t_r and t_s have the same value on each of the attributes in $R \cap S$, add a tuple t to the result, where
    - t has the same value as t_r on r
    - t has the same value as t_s on s

CARTESIAN PRODUCT BETWEEN R AND S + KEEP ONLY THE ROWS HAVING THE SAME VALUE ON COMMON ATTRIBUTES OF R AND S + REMOVE REDUNDANT ATTRIBUTES (I.E., KEEP JUST THE R OR S COPY OF THOSE IN COMMON)

Natural Join Example

- Relations r, s:

A	B	C	D
α	1	α	a
β	2	γ	a
γ	4	β	b
α	1	γ	a
δ	2	β	b

r

B	D	E
1	a	α
3	a	β
1	a	γ
2	b	δ
3	b	ε

s

- Natural Join
  - $r \bowtie s$

A	B	C	D	E
α	1	α	a	α
α	1	α	a	γ
α	1	γ	a	α
α	1	γ	a	γ
δ	2	β	b	δ

THERE IS ALSO THE MORE GENERAL THETA JOIN OPERATION, WHICH ALLOWS US TO SPECIFY THE FILTERING CONDITION:

$$r \bowtie_{A=C} s$$

$$\Pi_{A,\ r.B,\ C,\ r.D,\ E}(\sigma_{r.B = s.B \wedge r.D = s.D}(r \times s)))$$

Summary of Relational Algebra Operators

Symbol (Name)	Example of Use
σ (Selection)	$\sigma_{\text{salary} >= 85000}(\textit{instructor})$
	Return rows of the input relation that satisfy the predicate.
Π (Projection)	$\Pi_{\textit{ID, salary}}(\textit{instructor})$
	Output specified attributes from all rows of the input relation. Remove duplicate tuples from the output.
x (Cartesian Product)	*instructor* x *department*
	Output pairs of rows from the two input relations that have the same value on all attributes that have the same name.
$\cup$ (Union)	$\Pi_{\textit{name}}(\textit{instructor}) \cup \Pi_{\textit{name}}(\textit{student})$
	Output the union of tuples from the *two* input relations.
– (Set Difference)	$\Pi_{\textit{name}}(\textit{instructor})$ -- $\Pi_{\textit{name}}(\textit{student})$
	Output the set difference of tuples from the two input relations.
$\bowtie$ (Natural Join)	*instructor* $\bowtie$ *department*
	Output pairs of rows from the two input relations that have the same value on all attributes that have the same name.

Non è possibile visualizzare l'immagine.

End of Chapter 2

Database System Concepts, 6th Ed.