WIN 23- Lecture 11
JAN 11, 2023

NOTES

Recap:

ε Additional operators:

a) Natural Joins ($\bowtie$)
b) Intersection
c) Division / Quotent ($\div$)
d) Θ-joins. ($\bowtie_\theta$)

a) Natural Join:

Let: $r(R)$, $s(S)$ be relations
lets assume $R \cap S = \{A_1, A_2, \dots, A_k\}$

$$r \bowtie s = \prod_{R \cup S} \left(\sigma_{\substack{r.A_1 = s.A_1, \\ r.A_2 = s.A_2, \\ r.A_3 = s.A_3, \\ \vdots \\ r.A_k = s.A_k}} (r \times s) \right)$$

ε Division or Quotient Operator ($\div$):

$r(R)$:

A	B
p	a
q	a
p	b
p	c
q	b

$s(S)$:

B
a
b

NOTE: $S \subset R$

$(r \div s)$:

A
p
q

working:

$r(R)$:

A	B
p	a
q	a
p	b
p	c
q	b

$s(S)$:

B
a
b

NOTE: (i) Attributes of $(r \div s) = R - S$

(ii) result should have all combinations of R&S.

Eg: SUPPLIER (ACC-NO, S-NAME, PRICE, DOS)

BORROW (ACC-NO, CARD-NO, DOI)

BOOK (ACC-NO, YR-PUB, TITLE)

Determine the output of the following query in RA.

$$\Pi_{ACC\text{-}NO,\ S\text{-}NAME}(SUPPLIER) \div \Pi_{ACC\text{-}NO}\left(\sigma_{CARD\text{-}NO = 'F53'}(BORROW)\right)$$

soln:

ACC-NO	S-NAME
⋮	⋮

$\div$

ACC-NO
⋮

=

S-NAME
⋮

→ will contain supplier names of books borrowed by CARD-NO: "F53"

Try yourself:

Determine the output of the following query in RA.

$$\Pi_{TITLE,\, SNAME}(SUPPLIER \bowtie BOOK) \div \Pi_{TITLE}\left(\sigma_{CARD\_NO = F53}(BOOK \bowtie BORROW)\right)$$

θ-Join ($\bowtie_\theta$) operator:

$$r \bowtie_\theta S = \sigma_\theta (r \times S)$$

NOTE:

θ ÷ allows for conditions that are beyond just "="

Natural join is a $\subset$ of θ join.

Extended Relational Algebra:

Outer Join: (Extension of the θ join)

~~retaions~~ allows for the retention of additional attributes that a normal θ-Join allows.

process involved:

① Join the 2 relations - using θ

② Add additional tuples to the result.

Here we will use the value of "NULL"

Types of outer Joins:

a) Left outer Join ($⟕_\theta$)

b) Right Outer Join ($⟖_\theta$)

a) Left outer Join:

r ⟕$_\theta$ s

retains every tuple from the left relation even if it does not obey join condition 'θ'.

Eg: r(R):

A	B
1	5
2	6
3	7

s(S):

A	C
1	7
2	8
4	9

step 1: r ⋈ s

A	B	C
1	5	7
2	6	8

step 2: r ⟕ s

A	B	C
1	5	7
2	6	8
3	7	NULL

b) Right Outer Join:

r ⟖ s :

A	B	C
1	5	7
2	6	8
4	NULL	9

SPECIAL Full Outer Join r ⟗ s

A	B	C
1	5	7
2	6	8
3	7	NULL
4	NULL	9

Extended Relational Algebra:

- → Generalized projections
- → Aggregations

Generalized projections: (allows arithmatic operations on Π)

$$\Pi_{f_1, f_2, \ldots f_n}(E)$$

functions

r

A	B	C
1	1	5
1	2	5
2	3	5
2	4	8

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

B-A	C
0	5
1	5
~~1~~	~~5~~
2	8

duplicates are removed.

try: $\Pi_{2B-A, C}(r)$

b) Aggregation: allows for grouping of tuples

uses functions of avg, min, max, sum, & count to summarize groupings

$$_{g_1, \ldots, g_k}\mathcal{G}_{f_1, f_2, \ldots, f_n}(E)$$

order of execution

step 2

$$_{g_1, \ldots, g_k}\mathcal{G}_{f_1, f_2, \ldots, f_n}(E)$$

step 1

Eg: r

A	B	C
1	1	5
1	2	5
2	3	5
2	4	8
3	3	9

a) $\mathcal{G}_{sum(c)}(r) \Rightarrow$ result = 32

b) $_{A}\mathcal{G}_{sum(c)}(r) \Rightarrow$

A	sum(C)
1	10
2	13
3	9

Database Modification

Three basic operations can modify a database

a) Deletion
b) Insertion
c) Update

} DDL commands

a) Deletion: $r \leftarrow r - E$

expression

here only tuples can be deleted.

Eg: r

A	B	C
1	1	5
1	2	5
2	3	5
2	4	8

$r \leftarrow r - (\sigma_{A=1}(r))$

$r \leftarrow r -$ (all rows where $A=1$)

result: r

A	B	C
2	3	5
2	4	8

b) Insertion: $r \leftarrow r \cup E$

c) Updating: $r \leftarrow \Pi_{f_1, f_2, \dots, f_n}(r)$

attributes / expressions on attributes

$r \leftarrow \Pi_{A,\, 2*B,\, C}(r)$

$r \leftarrow \Pi_{A,\, 2*B,\, C}(\sigma_{A=1}(r))$

These three operations can violate the Integrity constraints of a database.