CSE 4125: Distributed Database Systems
Chapter – 2: Part C

Review of Databases and Computer Networks

Symmetric?

$$\begin{pmatrix} 1 & 1 \\ 1 & 1 \end{pmatrix} \cdot \begin{pmatrix} 1 & 2 \\ 2 & 3 \end{pmatrix} = \begin{pmatrix} 3 & 5 \\ 3 & 5 \end{pmatrix}$$

while

$$\begin{pmatrix} 1 & 2 \\ 2 & 3 \end{pmatrix} \cdot \begin{pmatrix} 1 & 1 \\ 1 & 1 \end{pmatrix} = \begin{pmatrix} 3 & 3 \\ 5 & 5 \end{pmatrix}.$$

Which Relational Algebra is symmetric?

- Selection
- Projection
- Union
- Difference
- Cartesian product
- Join
- Natural Join
- Semi join
- Natural Semi Join

Prove that, semi – join is not symmetric.

The Relational Model

- ✓ Grade: Number of columns
- ✓ Cardinality: Number of rows

Unary: Selection

Example: $SL_{A=a}\ R$

Selection operation affect Row

R		
A	**B**	**C**
a	1	a
b	1	b
a	1	d
b	2	f

S		
A	**B**	**C**
a	1	a
a	3	f

T		
B	**C**	**D**
1	a	1
3	b	1
3	c	2
1	d	4
2	a	3

Result		
A	**B**	**C**
a	1	a
a	1	d

G(Result) = G(R)

Unary: Projection

Example: $\boldsymbol{PJ}_{A,B}\ \boldsymbol{R}$

R

A	B	C
a	1	a
b	1	b
a	1	d
b	2	f

S

A	B	C
a	1	a
a	3	f

T

B	C	D
1	a	1
3	b	1
3	c	2
1	d	4
2	a	3

Result

A	B
a	1
b	1
b	2

G(Result) <= G(R)

Binary: Union

Example: *R* ***UN*** *S*

In case of R UN T, the order of R & the order of T does not match. So we cant perform UN operation.

R

A	B	C
a	1	a
b	1	b
a	1	d
b	2	f

char, number, char

S

A	B	C
a	1	a
a	3	f

T

B	C	D
1	a	1
3	b	1
3	c	2
1	d	4
2	a	3

number, char, number

Result

A	B	C
a	1	a
b	1	b
a	1	d
b	2	f
a	3	f

G(Result) = G(R) = G(S)

Binary: Difference

Example: *R* ***DF*** *S*

R		
A	**B**	**C**
a	1	a
b	1	b
a	1	d
b	2	f

S		
A	**B**	**C**
a	1	a
a	3	f

T		
B	**C**	**D**
1	a	1
3	b	1
3	c	2
1	d	4
2	a	3

Result		
A	**B**	**C**
b	1	b
a	1	d
b	2	f

G(Result) = G(R) = G(S)

Binary: Cartesian Product

Example: $R \; \boldsymbol{CP} \; S$

G(Result) = G(R) + G(S)

R		
A	**B**	**C**
a	1	a
b	1	b
a	1	d
b	2	f

S		
A	**B**	**C**
a	1	a
a	3	f

T		
B	**C**	**D**
1	a	1
3	b	1
3	c	2
1	d	4
2	a	3

Result					
R.A	**R.B**	**R.C**	**S.A**	**S.B**	**S.C**
a	1	a	a	1	a
b	1	b	a	1	a
a	1	d	a	1	a
b	2	f	a	1	a
a	1	a	a	3	f
b	1	b	a	3	f
a	1	d	a	3	f
b	2	f	a	3	f

Binary: Join

Example: $R \; \boldsymbol{JN}_{R.C=T.C} \; T$

G(Result) = G(R) + G(S)

R		
A	**B**	**C**
a	1	a
b	1	b
a	1	d
b	2	f

S		
A	**B**	**C**
a	1	a
a	3	f

T		
B	**C**	**D**
1	a	1
3	b	1
3	c	2
1	d	4
2	a	3

Result					
A	**R.B**	**R.C**	**T.B**	**T.C**	**D**
a	1	a	1	a	1
a	1	a	2	a	3
b	1	b	3	b	1
a	1	d	1	d	4

Binary: Natural Join

Example: *R **NJN** T*

R

A	B	C
a	1	a
b	1	b
a	1	d
b	2	f

S

A	B	C
a	1	a
a	3	f

T

B	C	D
1	a	1
3	b	1
3	c	2
1	d	4
2	a	3

Result

A	B	C	D
a	1	a	1
a	1	d	4

G(Result) = G(R) + G(S) - No of common column

G(Result) < G(R) + G(S)

Binary: Semi-join

Example: $R \; \boldsymbol{SJ}_{R.C=T.C} \; T$

R		
A	**B**	**C**
a	1	a
b	1	b
a	1	d
b	2	f

S		
A	**B**	**C**
a	1	a
a	3	f

T		
B	**C**	**D**
1	a	1
3	b	1
3	c	2
1	d	4
2	a	3

Result		
A	**B**	**C**
a	1	a
b	1	b
a	1	d

G(Result) = G(R)

Binary: Natural Semi-join

Example: *R* ***NSJ*** *T*

R		
A	**B**	**C**
a	1	a
b	1	b
a	1	d
b	2	f

S		
A	**B**	**C**
a	1	a
a	3	f

T		
B	**C**	**D**
1	a	1
3	b	1
3	c	2
1	d	4
2	a	3

Result		
A	**B**	**C**
a	1	a
a	1	d

G(Result) = G(R)

- Join is Cartesian Product of two relations followed by a selection operation.

- Semi-join is Join between two relations followed by a projection operation.

Sample Questions

a) If *R* and *S* are the input relations, and *T* is the output relation, for which relational algebraic operation(s) the following statements are true?

   i. grade(R) = grade(S) = grade(T) R UN S

   ii. grade(R) + grade(S) = grade(T) R JN S, R CP S

b) Give examples of protocol and session from the context of DDB.