Relational Algebra

Relations

A relation on N sets is a subset of the Cartesian product of the N sets.

Example Relations

R

name	address	gender	birthdate
Carrie Fisher	123 Maple St., Hollywood	F	9/9/99
Mark Hamill	456 Oak Rd., Brentwood	M	8/8/88

S

name	address	gender	birthdate
Carrie Fisher	123 Maple St., Hollywood	F	9/9/99
Harrison Ford	789 Palm Dr., Beverly Hills	M	7/7/77

Operations

Set Operations

- Union
- Intersection
- Difference

"Slicing" Operations

- Selection
- Projection

"Combining" Operations

- Product
- Natural Join
- Theta Join

Renaming

Notation

$R \cup S$ (union)

$R \cap S$ (intersection)

$R - S$ (difference)

$R \times S$ (product)

$R \bowtie S$ (natural join)

$R \bowtie_{\theta} S$ (theta join)

$\sigma_{\theta} (R)$ (selection)

$\pi_{\theta} (R)$ (projection)

$\rho_{S(A1, A2,...)} (R)$ (renaming)

Examples

R

A	B
1	2
3	4

S

A	B
2	5
3	4
9	10

$R \cup S$

A	B
1	2
3	4
2	5
9	10

$R \cap S$

A	B
3	4

$R - S$

A	B
1	2

Examples

R

A	B
1	2
3	4

S

B	C	D
2	5	6
4	7	8
9	10	11

$\sigma_{C=7}(S)$

B	C	D
4	7	8

$\pi_{C,D}(S)$

C	D
5	6
7	8
10	11

Examples

R

A	B
1	2
3	4

S

B	C	D
2	5	6
4	7	8
9	10	11

R × S

A	R.B	S.B	C	D
1	2	2	5	6
1	2	4	7	8
1	2	9	10	11
3	4	2	5	6
3	4	4	7	8
3	4	9	10	11

Examples

R

A	B
1	2
3	4

S

B	C	D
2	5	6
4	7	4
9	10	2

$R \bowtie S$

A	B	C	D
1	2	5	6
3	4	7	4

$R \bowtie_{R.B=S.D} S$

A	R.B	S.B	C	D
1	2	9	10	2
3	4	4	7	4

Examples

R

A	B
1	2
3	4

S

B	C	D
2	5	6
4	7	4
9	10	2

$\rho_{T(X, Y, Z)}$ (S)

X	Y	Z
2	5	6
4	7	4
9	10	2

This relation is now called T.

Problem #1

Consider the following relation:

```
Movies(title, year, length, genre, studioName, producerId)
```

Write a relational algebra expression to answer the following question:

What are the titles and years of movies made by Fox that are at least 100 minutes long?

$$\pi_{\text{title, year}} (\sigma_{\text{studioName='Fox'}} (\textbf{Movies}) \cap \sigma_{\text{length >= 100}} (\textbf{Movies}))$$

Problem #2

Consider the following relations:

```
MovieStar(name, address, gender, birthdate)

Movies(title, year, length, genre, studioName, producerId)

StarsIn(movieTitle, movieYear, starName)
```

What were the titles and years of all movies longer than 120 minutes that starred women born on '02-14-1977'?

$$\pi_{\text{title, year}} (\sigma_{\text{gender='F' AND birthdate='02-14-1977'}} (\text{MovieStar}) \bowtie_{\text{name=starName}} (\text{StarsIn} \bowtie_{\text{title=movieTitle AND year=movieYear}} \sigma_{\text{length > 120}} (\text{Movies})))$$