

Databases - Jan 24 - Relational Algebra

Mathematical language to express QUERY: question that we ask our database.

Operations

Regular: $+$, $-$, $*$, $/$, $\sqrt{\quad}$, ...

Boolean: \wedge , \vee , \neg , \rightarrow

Relational: Union (\cup)
 intersection (\cap)
 difference ($-$)

Assume that we have 2 relations w/ identical schemas.

$R \cup S$, $R \cap S$, $R - S \rightarrow$ only possible if R & S have identical schemas.

union: all rows present in either R or S or both
intersection: all rows present in R and S
difference: all rows in R except those that also appear in S .

Ex: Students \cup Professors? \rightarrow table of 8 rows:

last	first

Students \cap Professors? \rightarrow table w/ only 1 row:

last	first
Longb	Neville

Gryffindors $-$ Students?

Students $-$ Gryffindors \rightarrow Draco Malfoy

last	first
McG	Minerva
Dum	Albus

π (Projection operator)

Takes one relation, produces a new relation w/ only certain columns.

$\pi_{A_1, A_2, A_3, \dots}(R)$ } gives me a new relation w/ only the attributes A_1, A_2, A_3, \dots of R .

↓
attributes of R

↑
relation

$\pi_{name}(Students)$? — Students table but only w/ the name col. relation w/ 6 rows, 1 col.

$\pi_{major}(Students)$? —

major
CS
math
physics

dept
CS
math
physics
music

$\pi_{dept}(Courses)$? —

$\pi_{dept, seats}(Courses)$?
how many rows?

σ (Selection operator)

↑
sigma

Takes a relation, produces a new relation w/ only certain rows.

Syntax $\sigma_{condition}(R)$ } gives me a copy of R but only w/ rows that satisfy the condition.

(boolean)

\neq
 \rightarrow
 \Rightarrow

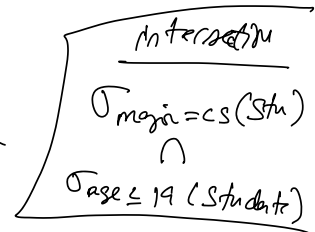
↑
something in an "if" statement

$\sigma_{major=CS}(Students)$ — Asking for all rows of Students who are CS majors:

name	id	major	age
Alice	—	CS	—
Carol	—	CS	—
Don	—	CS	—

$\sigma_{\text{dept}=\text{music}}$ (Courses) : Select all rows w/ music courses
2 rows

$\sigma_{\text{major}=\text{CS and age} \leq 19}$ (Students) : Alice, Carol
AND, &&, ^



ρ (Rename operator) : used to rename a relation and/or its attributes.
 ρ
↑
rho

Syntax : $\rho_S(A_1, A_2, \dots)$ (R) : gives me a copy of R, but renamed to S & attributes of R are renamed to A_1, A_2, \dots

$\rho_S(R)$: rename R, but leave the attrs alone.

Combining / Chaining operations

most common : selection, followed by projection

Ex : Give me a list of the names of all CS majors.

works $\rightarrow \pi_{\text{name}}(\sigma_{\text{major}=\text{CS}}(\text{Students})) \rightarrow$ 1 column table ~~(table)~~

bad $\rightarrow \sigma_{\text{major}=\text{CS}}(\pi_{\text{name}}(\text{Students}))$
doesn't work

Ex : Give me the CRN & names of all math or CS courses w/ < 20 seats.

$\pi_{\text{CRN, name}}(\sigma_{(\text{dept}=\text{CS or dept}=\text{math}) \text{ and seats} < 20}(\text{Courses}))$