Databases - Jan 24 - Relational Algebra

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

Operations

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

Boolean: $\wedge, \vee, \sim, \rightarrow$

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

] Assume that we have 2 relations w/ identical schemas.

$R \cup S$, $R \cap S$, $R - S$ → only possible if R+S have identical schemas.

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

Ex: Students ∪ Professors? → table of 8 rows:

last	first

Students ∩ Professors? → table w/ only 1 row:

last	first
Longb	Neville

Gryffindors − Students? →

last	first
McG	Minerva
Dum	Albus

Students − Gryffindors → Draco Malfoy

Π (Projection operator)

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

$\Pi_{A_1, A_2, A_3 \ldots}(R)$ — $A_1, A_2, A_3 \ldots$: attributes of R; R: relation

} gives me a new relation w/ only the attributes $A_1, A_2, A_3 \ldots$ of R.

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

$\Pi_{major}(Students)$? —

major
CS
math
physics

$\Pi_{dept}(Courses)$? —

dept
CS
math
physics
music

$\Pi_{dept, seats}(Courses)$?

how many rows?

σ (Selection operator)

σ: sigma

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

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

condition: 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	—
Dan	—	CS	—

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

2 rows

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

↑ AND, &&, ∧

intersection

$\sigma_{major=cs}(Stu) \cap \sigma_{age \leq 19}(Students)$

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

↑ rho

Syntax: $\rho_{S(A_1, A_2, \ldots)}(R)$: gives me a copy of R, but renamed to S & attributes of R are renamed to $A_1, A_2 \ldots$

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

Combining / Chaining operations

most common: selection, followed by projection

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

works → $\pi_{name}(\sigma_{major=cs}(Students))$ → 1 column table

bad → doesn't work $\sigma_{major=cs}(\pi_{name}(Students))$

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

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