

College(cname, state, enrollment)

Student(SID, Sname, GPA, HS)

Apply(SID, CName, Major, Decision)

SELECT OPERATION: Picks certain rows

(σ) - Sigma

Students with GPA > 3.7

$\sigma_{GPA > 3.7}$ Student

Students with GPA > 3.7 and HS > 1000

$\sigma_{GPA > 3.7 \wedge HS > 1000}$ Student

Applications to Stanford CS Major

$\sigma_{cname = 'Stanford' \wedge major = 'cs'}$ Apply

Generalize the select equation

σ_{cond} (Relation Name)

OR

σ_{cond} (Expressions)

PROJECT OPERATION: picks certain columns

(π) \Rightarrow dealing with sets
 \therefore we assume 'no duplicates'

ID and decision of all applications

$\pi_{sid, dec}$ Apply

Generalize the project operation

$$\pi_{A1 \dots An} (\text{Relation Name}) \text{ or } \pi_{A1 \dots An} (\text{Expression})$$

To pick rows and columns

ID and name of students with GPA > 3.7

$$\pi_{\text{sid, name}} \left(\sigma_{\text{GPA} > 3.7} \text{Student} \right)$$

Cross Product: Combine two relations (a.k.a Cartesian product)

(X) \Rightarrow Note: explicit condⁿ required for joining the columns

Names and GPAs of student with HS > 1000 who applied to CS and were rejected

$$\pi_{\text{Sname, GPA}} \left(\sigma_{\text{Student.sid} = \text{Apply.sid} \wedge \text{HS} > 1000 \wedge \text{major} = \text{'CS'} \wedge \text{dec} = \text{'rejected'}} (\text{Student} \times \text{Apply}) \right)$$

Natural Join (\bowtie) \Rightarrow Bow tie symbol [No explicit condⁿ]

Enforce equality on all attributes with same name

Eliminate one copy of duplicate attributes

Names and GPAs of student with HS > 1000 who applied to CS and were rejected

$$\pi_{\text{sname, GPA}} \left(\sigma_{\text{HS} > 1000 \wedge \text{major} = 'CS' \wedge \text{dec} = 'Reject'} (\text{Student} \bowtie \text{Apply}) \right)$$

Names and GPAs of student with HS > 1000 who applied to CS at college with enrollment > 20000 and were rejected

$$\pi_{\text{sname, GPA}} \left(\sigma_{\text{HS} > 1000 \wedge \text{major} = 'CS' \wedge \text{enr} > 20000 \wedge \text{dec} = 'reject'} (\text{Student} \bowtie \text{Apply} \bowtie \text{College}) \right)$$

$$\text{Exp}_1 \bowtie \text{Exp}_2 \cong \pi_{S(E_1) \cup S(E_2)} \left(\sigma_{E_1 A_1 = E_2 A_1, E_1 A_2 = E_2 A_2, \dots, E_1 A_n = E_2 A_n} (\text{Exp}_1 \times \text{Exp}_2) \right)$$

Theta Join (\bowtie_{θ})

Basic operation implemented in DB<S

Term "join" often means theta join

(only pass theta condition)

$$\text{Exp}_1 \bowtie_{\theta} \text{Exp}_2 \cong \sigma_{\theta} (\text{Exp}_1 \times \text{Exp}_2)$$

Union Operators (\cup)

List of college and student names

$$\pi_{\text{cname}} \text{College} \cup \pi_{\text{sname}} \text{Student}$$

Note: To make it to same schema, use
rename operator (ρ).

Note: Technically when doing union, the schema attribute should be same.

Difference Operator $(-)$

IDs of student who did not apply anywhere

$$\pi_{SID} \text{ Student} - \pi_{SID} \text{ Apply}$$

IDs and Name of students who did not apply anywhere

$$\pi_{Sname, sid} \left(\left(\pi_{SID} \text{ Student} - \pi_{SID} \text{ Apply} \right) \bowtie \text{ Student} \right)$$

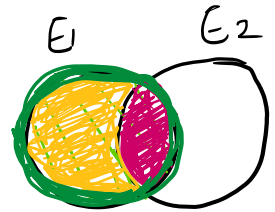
Intersection operator (\cap)

Names that are both a college name and a student name

$$\pi_{cname} \text{ College} \cap \pi_{sname} \text{ Student}$$

Note : Use Rename (ρ) to make it a same schema.

$$E_1 \cap E_2 = E_1 - (E_1 - E_2)$$



$$E_1 \cap E_2 \approx E_1 \bowtie E_2$$

E_1 - Green area

$E_1 - E_2 \rightarrow$ Yellow

$E_1 \cap E_2 =$ Red part

Rename operator ρ (row)

Different forms

$$\rho_R (A_1 \dots A_n) (E) \Rightarrow \text{General form}$$

$$\rho_R (E)$$

$$\rho_{A_1 \dots A_n} (E)$$

List of college and student names

$$\rho_{C(\text{name})} \left(\pi_{\text{name}} \text{College} \right) \cup \rho_{C(\text{name})} \left(\pi_{\text{name}} \text{Student} \right)$$

Expression Tree

GPA's of students applying to CS in Montreal

