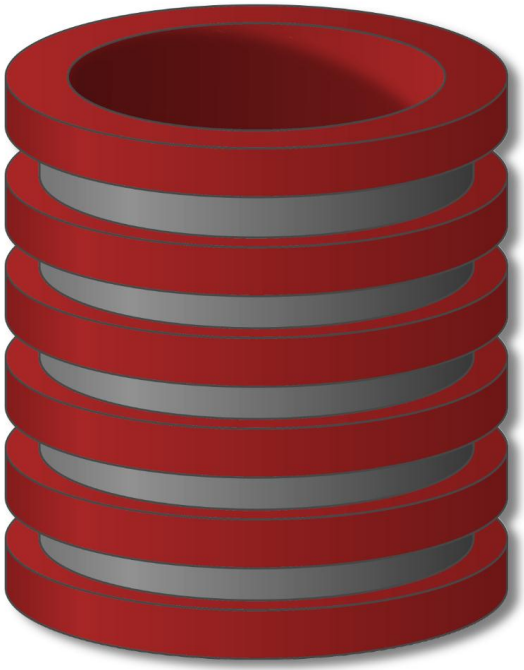


Relational Databases

Relational Algebra (2)

Set operators, renaming, notation

Jennifer Widom

Relational Algebra (2)

Relational algebra query (expression) on set of relations produces relation as a result

College(cName, state, enrollment)
Student(sID, sName, GPA, sizeHS)
Apply(sID, cName, major, decision)

College

cName	state	enr

Student

sID	sName	GPA	HS

Apply

sID	cName	major	dec

Union operator

List of college and student names

Stanford
Susan
Cornell
Mary
John
⋮

$\times$ $\bowtie_{t_1 - t_2}$ $\cup$

t_1
t_2

Π_{cName} College $\cup$

Π_{sName} Student

College

cName	state	enr

Student

sID	sName	GPA	HS

Apply

sID	cName	major	dec

Difference operator

IDs and names of students who didn't apply anywhere

$$((\Pi_{sID}\ Student - \Pi_{sID}\ Apply) \bowtie Student)$$

$$\Pi_{sName}$$

College

cName	state	enr

Student

sID	sName	GPA	HS

Apply

sID	cName	major	dec

Intersection operator

Names that are both a college name and a student name

$\Pi_{cName}(College) \cap \Pi_{sName}(Student)$

College

cName	state	enr

Student

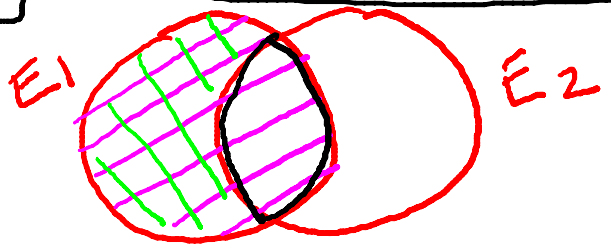
sID	sName	GPA	HS

Apply

sID	cName	major	dec

Intersection doesn't add expressive power (1)

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



College

cName	state	enr

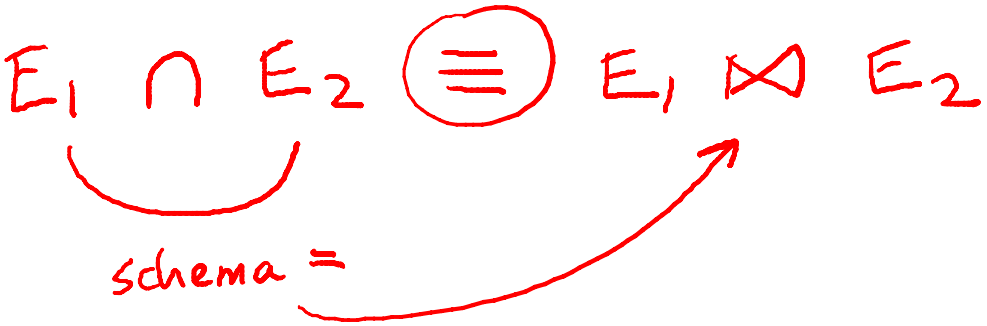
Student

sID	sName	GPA	HS

Apply

sID	cName	major	dec

Intersection doesn't add expressive power (2)



College

cName	state	enr

Student

sID	sName	GPA	HS

Apply

sID	cName	major	dec

Rename operator

1. $\rho_{R(A_1,\ldots,A_n)}(E)$ ← General ☆
2. $\rho_{R}(E)$
3. $\rho_{A_1,\ldots,A_n}(E)$

College

cName	state	enr

Student

sID	sName	GPA	HS

Apply

sID	cName	major	dec

Rename operator

To unify schemas for set operators

List of college and student names

$$\rho_{C(name)}(\Pi_{cName}\ College) \cup \rho_{C(name)}(\Pi_{sName}\ Student)$$

College

cName	state	enr

Student

sID	sName	GPA	HS

Apply

sID	cName	major	dec

Rename operator

For disambiguation in "self-joins"

Pairs of colleges in same state

$$\sigma_{n1<n2}\left(\rho_{C1(n1,s,e1)}(College) \bowtie \rho_{C2(n2,s,e2)}(College)\right)$$

Berkeley Stanford

College

cName	state	enr

Student

sID	sName	GPA	HS

Apply

sID	cName	major	dec

Alternate notation (1)

Assignment statements – *Pairs of colleges in same state*

$C1 := \rho_{c1,s,e1}\ College$

$C2 := \rho_{c2,s,e2}\ College$

$CP := C1 \bowtie C2$

$Ans := \sigma_{n1<n2}\ CP$

College

cName	state	enr

Student

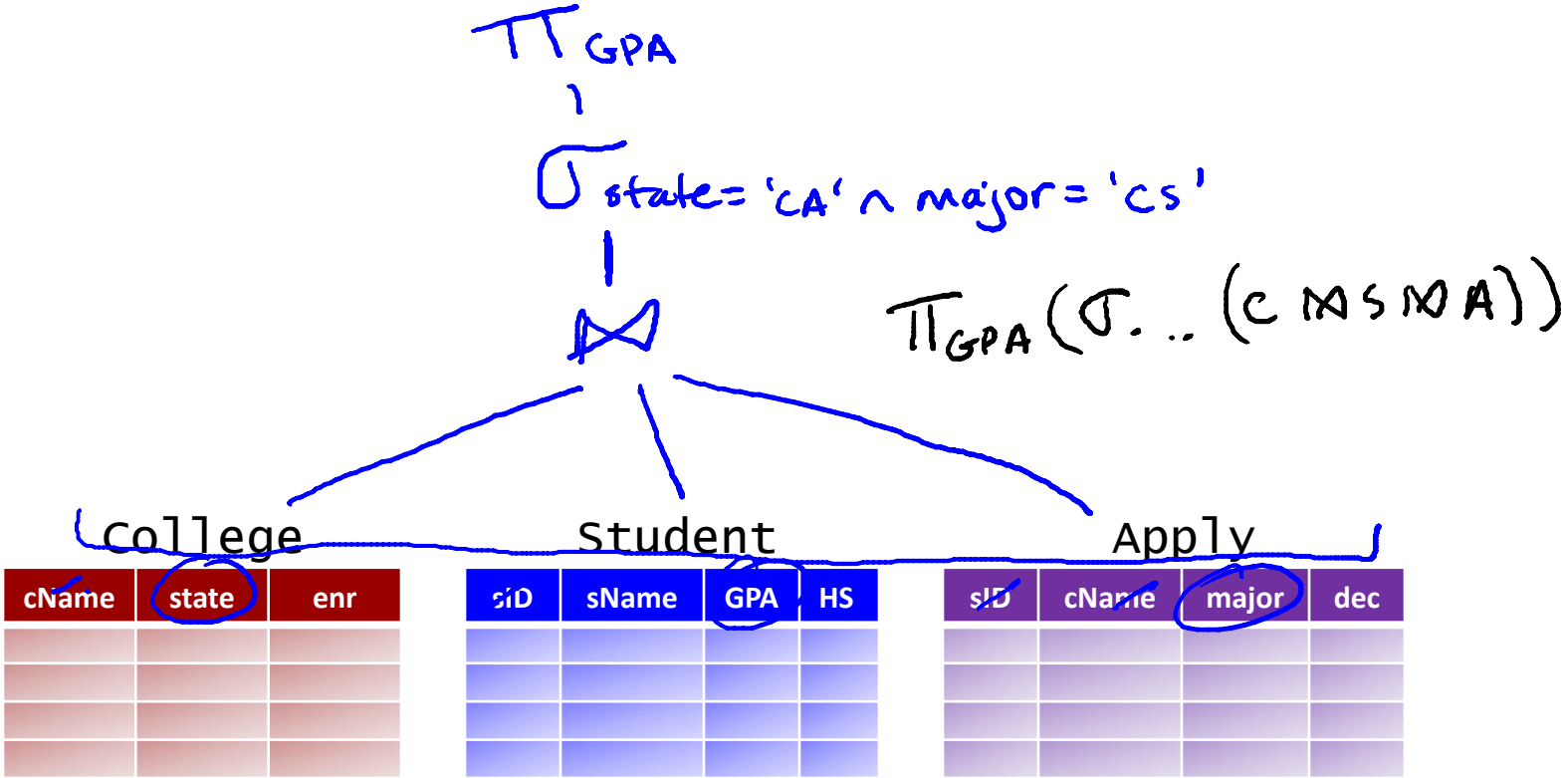
sID	sName	GPA	HS

Apply

sID	cName	major	dec

Alternate notation (2)

Expression tree – *GPAs of students applying to CS in CA*



$\Pi_{GPA}(\sigma_{\ldots}(C \bowtie S \bowtie A))$

Relational Algebra summary

Core

R

$\sigma_C(E)$

$\Pi_{A_1,\ldots,A_n}(E)$

$(E_1) \times (E_2)$

$E_1 \cup E_2$

$E_1 - E_2$

$\rho_{R(A_1,\ldots,A_n)}(E)$

Abbrev.

$E_1 \bowtie E_2$

$E_1 \bowtie_\theta E_2$

$E_1 \cap E_2$

Webcam Video
(delete this
in final version!)