Databases: Relational Algebra

Students

Last	First
Potter	Harry
Granger	Hermione
Weasley	Ron
Longbottom	Neville
Malfoy	Draco

Professors

Last	First
McGonagall	Minerva
Snape	Severus
Longbottom	Neville
Dumbledore	Albus

Gryffindors

Last	First
Potter	Harry
Granger	Hermione
Weasley	Ron
McGonagall	Minerva
Longbottom	Neville
Dumbledore	Albus

Name	ID	Major	Age
Alice	1	CS	18
Bob	2	Math	20
Carol	3	CS	19
Dan	4	CS	20
Eva	5	Math	21
Frank	6	Physics	18

Students Key = ID

CRN	Dept	CourseName	Seats
101	CS	Databases	20
102	CS	Discrete Structures	15
103	CS	Graphics	25
104	Math	Linear Algebra	18
105	Math	Differential Equations	20
106	Music	Piano Lessons	10
107	Physics	Optics	16
108	Music	Music Theory	21
109	Physics	Modern Physics	15
110	Math	Number Theory	20

Courses Key = CRN

Enrolled Key = (ID, CRN)

ID (CRN
1	101
1	102
2	104
2	105
3	101
3	104
4	103
5	108
5	105
5	110
6	107
6	110
6	106

Cartesian Product

	A	B	B	C	D	A	R.B	S.B	C	D	
	1	2	2	5	6	1	2	2	5	6	
	3	4	4	7	8	1	2	4	7	8	
			9	10	11	1	2	9	10	11	
(a)	Rel	ation R			'	3	4	2	5	6	
			(b) I	Relati	ion S	3	4	4	7	8	
						3	4	9	10	11	

(c) Result $R \times S$

Natural Join

(a) Relation U

A	B	C		B	C	D
1	2 7 7	3	,	2	3 3 8	4
6	7	8		2	3	5
9	7	8		7	8	10
'		•		,		

(b) Relation V

A	B	C	D
1	2	3	4
1	2	3	5
6	7	8	10
9	7	8	10

(c) Result $U \bowtie V$

(Natural) joins can be incomplete

 If a tuple from one relation doesn't have a "counterpart" in the other relation, it doesn't contribute to the join ("dangling" tuple):

r ₁	
Employee	Department
Smith	sales
Black	production
White	production

r ₂	
Department	Head
production	Mori
purchasing	Brown

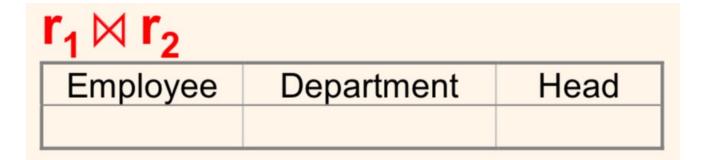
$\mathbf{r_1} \bowtie \mathbf{r_2}$		
Employee	Department	Head
Black	production	Mori
White	production	Mori

(Natural) joins can be empty!

• If no tuple has a counterpart, then the resulting relation is empty.

r ₁	
Employee	Department
Smith	sales
Black	production
White	production

r ₂	
Department	Head
marketing	Mori
purchasing	Brown



New Database!

Database schema:

Person(name, age, school)

Frequents(name, pizzeria)

Eats(name, pizza)

Serves(pizzeria, pizza, price)

name is a key

(name, pizzeria) is a key

(name, pizza) is a key

(pizzeria, price) is a key

school is either "Rhodes" or "U of M" pizzeria is the name of a pizza restaurant (e.g., "Memphis Pizza Café," "Aldo's" etc) pizza is a type of pizza (e.g., "pepperoni," "cheese," "pineapple,"...)