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	Students
Carol	3	CS	19	
Dan	4	CS	20	Key – ID
Eva	5	Math	21	
Frank	6	Physics	18	

CRN	Dept	CourseName	Seats	
101	CS	Databases	20	
102	CS	Discrete Structures	15	Cou
103	CS	Graphics	25	Кеу
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	

Cou	rs	es
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



(c) Result $R \times S$

Natural Join



(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		r ₂
Employee	Department	_ Denerting
Smith	sales	Departme
Black	production	productio
White	production	purchasii

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		r ₂
Employee	Department	D
Smith	sales	
Black	production	
White	production	р
	•	

r ₂	
Department	Head
marketing	Mori
purchasing	Brown

Department	Head
	Department

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," "Broadway Pizza," etc) pizza is a type of pizza (e.g., "pepperoni," "cheese," "pineapple,"…)