Common Query

- □ Library microDB:
 - Librarian (<u>SSN</u>, Name, SNO)
 - Section (SNO, SName, Head)
- List the names of head librarians.
- □ How?

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List the names of head librarians

□ L: Librarian, S: Section

LS ← Librarian X Section;

LS schema: (L.SSN,L.Name,L.SNO, S.SNO,S.Sname, S.Head)

 $HL \leftarrow \sigma_{L.SSN = S.Head}$ (LS);

 $RSLT \leftarrow \Pi_{L,name} (HL);$

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Equi-Join



- $r \bowtie r \bowtie r.Ai = s.Aj S$
- =-join is a macro of

$$\sigma_{r.Ai = s.Aj}(r \times s)$$

 \Box =-join of r(R) and s(S):

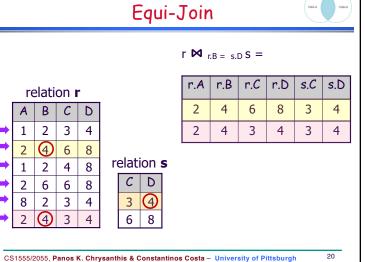
$$r \bowtie_{r.B = s.D} s = ?$$

relation r

		1		3	4		
				2	4	6	8
relation s			1	2	4	8	
	С	D		2	6	6	8
	3	4		8	2	3	4
	6	8		2	4	3	4

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relation r relation s 2 4 С 3 4 6



Θ-Join

- $\Box \Theta = \{ =, <, \leq, >, \geq, \neq \}$
- □ Θ-join of r(R) and s(S) on attributes r.A_i and s.A_i

$$r \bowtie_{r,Ai \theta_{s,Aj}} S$$

= $\sigma_{r,Ai \theta_{s,Aj}} (r \times s)$

ightharpoonup \geq -join of r(R) and s(S):

$$r \bowtie_{r,B \ge s,D} s = ?$$

relation r

Α	В	С	D
1	2	3	4
2	4	6	8
1	2	4	8
2	6	6	8
8	2	3	4
2	4	3	4

relation s

С	D
3	4
6	8

relation r

В

4 6 8

2

2

6 6

relation s

CD

3

4

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Example of Θ -Join

 \bigcirc \geq -join of r(R) and s(S):

$$r \bowtie_{r,B \geq s,D} s =$$

r.A	r.B	r.C	r.D	s.C	s.D
2	4	6	8	3	4
2	4	3	4	3	4
2	6	6	8	3	4
8	9	3	4	3	4
8	9	3	4	6	8

 \square r \bowtie s = r \bowtie s, Θ = ϕ

relation r								
	Α	В	С	D				
	1	2	3	4				
	2	4	6	8				
	1	2	4	8				
	2	6	6	8				
	8	9	3	4				
	2	4	3	4				

relation s

С	D
3	4
6	8

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Natural-Join

- Equi-join without duplicate columns r *_P S
- □ P=list of attributes: P=R ∩ S
- $r*s = \prod_{R \cup S} (r \bowtie_{r,P = s,P} s)$
- r*s = ?

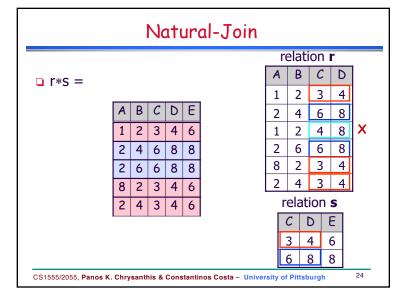


- □ Note other notations & meanings
 - $r \bowtie s = r * s, R \cap S \neq \phi$
 - r * s = r x s, $R \cap S = \phi$

Schema:

D Е 6 4 8

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Examples from Library DB

- □ Library DB schema:
 - LIBRARIAN(Name, SSN, SNO, BirthPlace)
 - SECTION(SName, NO, Head)
 - OUTREACH(Pname(PNO, SNUM, Location))
 - WORKSON(LSSN,PNO,Hours)
- Q: For every outreach activity located in PGH, list its project number, the responsible section name and the name of its head.

```
\begin{split} & \mathsf{PP} \leftarrow \sigma_{\mathsf{Location}\,=\,\mathsf{'Pgh'}}(\mathsf{OUTREACH}); \\ & \mathsf{SPP} \leftarrow \mathsf{PP} \bowtie_{\mathsf{SNUM}\,=\,\mathsf{SNO}}\,\mathsf{SECTION}; \\ & \mathsf{HSPP} \leftarrow \mathsf{SPP} \\ & \bowtie_{\mathsf{SNO}\,=\,\mathsf{SNO}\,\,\wedge\,\mathsf{Head}=\mathsf{SSN}}\,\mathsf{LIBRARIAN}; \\ & \mathsf{RSLT} \leftarrow \pi_{\mathsf{PNO},\,\mathsf{Sname},\,\mathsf{Name}}(\mathsf{HSPP}); \end{split}
```

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Alternative Inefficient Solution

- □ Library DB schema:
 - LIBRARIAN(Name, SSN, SNO, BirthPlace)



- SECTION(SName, NO, Head)
- OUTREACH(Pname, PNO, SNUM, Location)
- WORKSON(LSSN,PNO,Hours)
- Q: For every outreach activity located in PGH, list its project number, the responsible section name and the name of its head.

```
LS \leftarrow SECTION * LIBRARIAN;

OLS \leftarrow OUTREACH \bowtie SNUM = SNO LS;

POLS \leftarrow \sigma_{\text{Location}} = \text{'Pgh'}(\text{OLS});

PHL \leftarrow \sigma_{\text{Head}} = \text{SSN} (POLS);

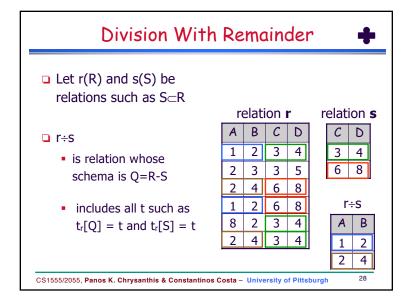
RSLT \leftarrow \pi_{\text{PNO Sname Name}}(\text{PHL});
```

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Division □ Let r(R) and s(S) be relations such as SCR relation r relation s C $C \mid D$ □ The division of r by s, 3 3 4 1 2 denoted by r+s, 6 8 2 4 6 8 is relation whose ال<u>2</u> 6 8 schema is Q=R-S and 3 r÷s includes all t such as $t_r[Q] = t$ and $t_r[S] = t$ 2 4

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Division Usage

☐ Query: "Retrieve the names of students who took all the classes that John took."

Q=ENROLL+CLASS

	_
FN	LN
S	Α
K	L

ENROLL					CLA	SS	
N	LN	DP	No		DP	No	
S	Α	CS	4		CS	4	
М	K	CS	5		EE	8	l
K	L	EE	8				
S	Α	EE	8				
F	S	CS	4				
K	L	CS	4				

Note:

Division can be expressed

using π , x and - operations: $r \div s = \pi_Q(r) - \pi_Q((\pi_Q(r) \times s) - r)$

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