Rel alg - procedural

SQL - non-procedural
- declarative

Rel alg: elem operations
$(\sigma, \pi, \rho, \cdot, \bowtie, \ldots)$

- many of them
output relations

= inputs:
(a) core rel alg:
set of tuple
(b) extended: bag of tuple

SQL: UNION ALL

$R \uplus S$ – "bag union"

(bag version of set union)

R:

A	B
1	2
3	4
1	2
5	6
3	4

S:

A	B
3	4
3	4
5	6
5	6

Bag union: output the unchanged inputs

$R \uplus S$:

A	B
1	2 - twice
3	4 - four times
5	6 - three times

R ∩ S

bag version of set intersection [min on # of copies in the input]

R ∩ S:

A	B
3	4
3	4
5	6

$R \pm S$ – bag version of set difference

$R \pm S$:

A	B
1	2
1	2

δ - eliminating duplicate

τ - sorting - potentially on several attributes

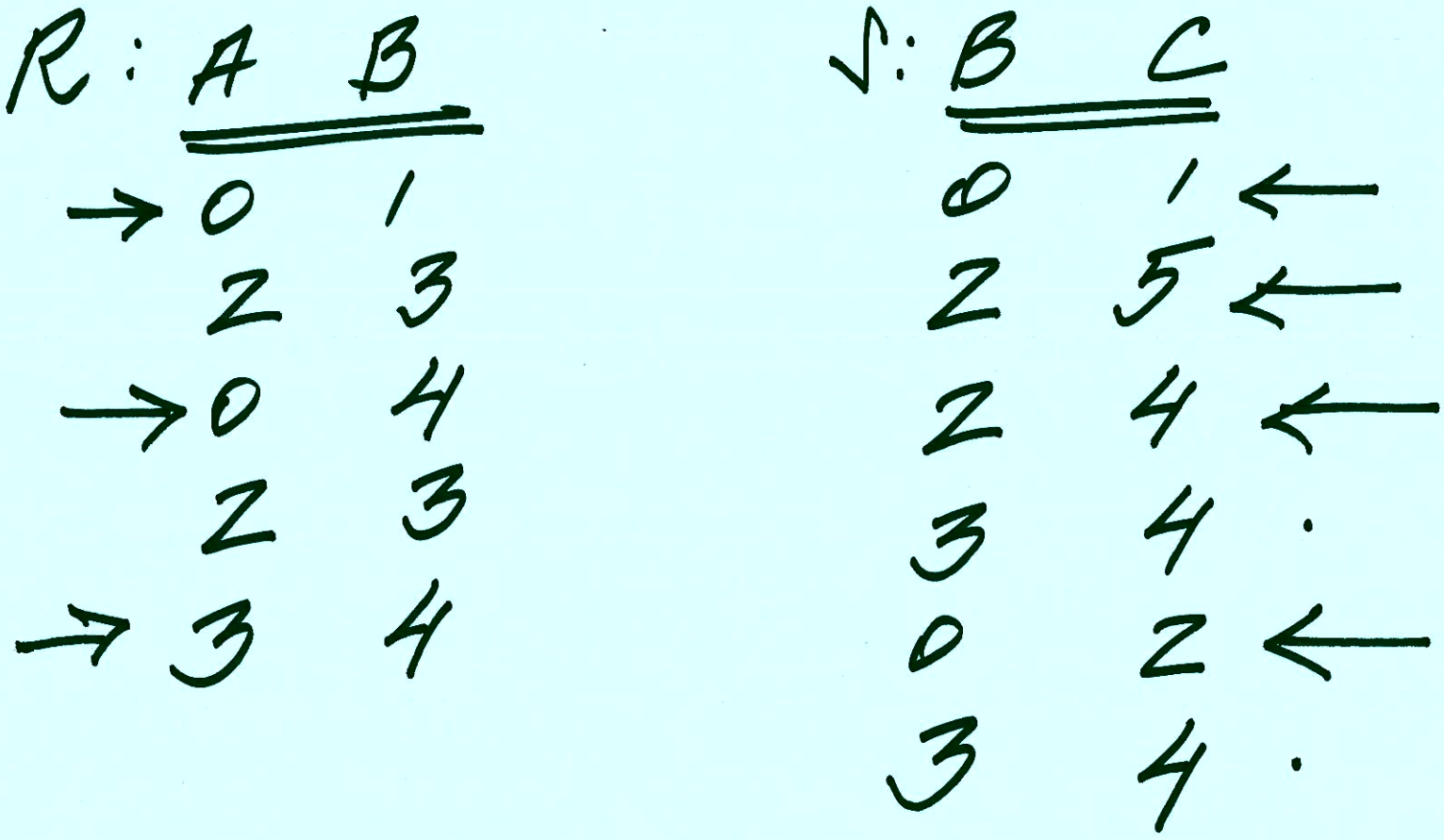
$\Rightarrow$ the output is a list

π generalized - arithmetic, duplicate columns, etc.

γ - grouping and aggregation.

= standard fns: COUNT, SUM, MIN, MAX, AVG, [CNTD]

$\overset{\circ}{\times}$ - outer join



$R \bowtie S$: natural join

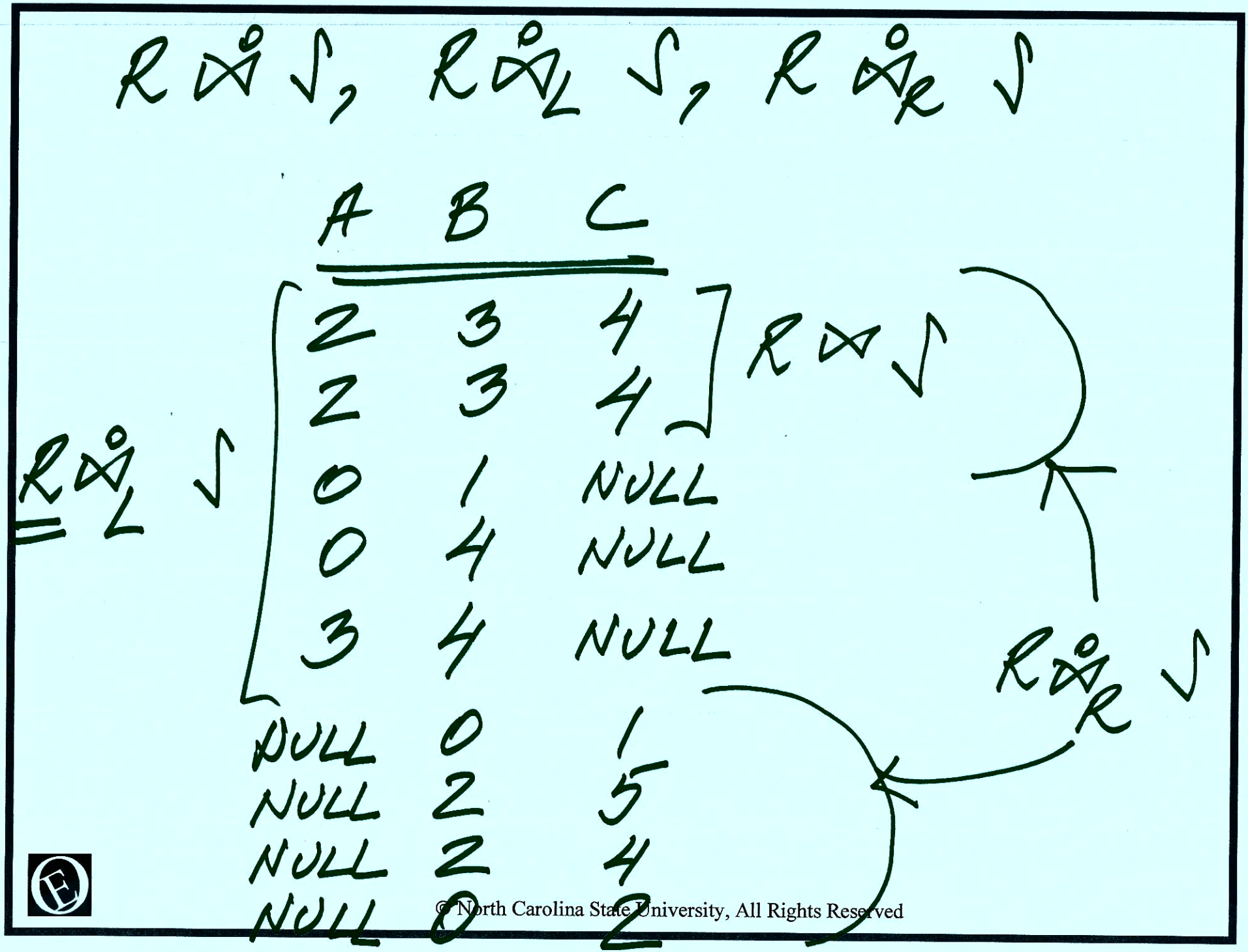
$R \overset{\circ}{\bowtie} S$: natural full outerjoin

$R \overset{\circ}{\bowtie}_L S$: natural left outerjoin

$R \overset{\circ}{\bowtie}_R S$: natural right outerjoin

$R \overset{\circ}{\times} S = R \times S$

$R \overset{\circ}{\bowtie}_{R.B<S.B} S$ full theta outerjoin



T:

A	B
1	2
1	2
3	4
5	6
5	6

U:

A	B
1	2
3	4
3	4
3	4
7	8

$\delta(U)$:

A	B
1	2
3	4
7	8

F(sorting): ASC [default]
DESC

F(W) by B, A

list:

A	B
4	1
1	2
1	3
2	3
2	3
2	5

W:

A	B	
1	3	
2	3	←
4	1	
2	3	←
2	5	
1	2	

$\tau_{A\ DESC}(H)$

$\Pi_{A, A-B, A}(T)$:

A	A-B	A
1	-1	1
1	-1	1
3	-1	3
5	-1	5
5	-1	5

$\mathcal{F}_{\mathcal{L}}(P)$

↑ individual attr names
and/OR aggregation fns
applied to attribute
names

P:	A	B	C
	1	2	3
.	4	5	1
.	4	6	2
	1	2	7
.	4	5	3
	1	2	7

$\gamma^{V}_{min(B)}(P) = 2$

$\gamma^{V}_{A,B}(P)$

$\gamma^{V}_{A,B,sum(C)}(P)$

Evaluating a $\gamma_L(R)$

[1] Partition R by values of the unaggregated attributes in the subscript L of γ

	A	B	C
(1,2) →	1	2	3
	1	2	7
	1	2	7
(4,5) →	4	5	1
	4	5	3
(4,6) →	4	6	2

[2] Within each individual partition, apply all the aggregation functions in the subscript L of γ_L

[3] For each individual partition, form and output a single tuple, with its values of all the unaggregated attributes in L, and with its value for each aggregate output

$\gamma^{(P)}_{A,B,\mathit{sum}(C)\to D} =$

A	B	~~sum(C)~~ D
1	2	17
4	5	4
4	6	2

$\gamma_{A,\,MIN(B),\,COUNT(C)}\left(\sigma^{(P)}_{C>3}\right)$

(1) only non-NULL values are considered

(2) If all the values are NULL ⇒ the aggregation

$\oplus, A, \pm$ – different from set ops

$R \cup R = R$

$R \oplus R \neq R$

SQL is declarative

- You are describing, in your query, a relation* that you want to see in the answer

* All student info:

SELECT [list of all the attrs]

FROM Student;

SELECT *

FROM Student;

All students with GPA > 3.7:

(3) SELECT *
(1) FROM Student
(2) WHERE GPA > 3.7;

$$\pi_{*}\left(\sigma_{GPA>3.7}\left(Student\right)\right)$$