



# WEEK 4

THE RELATIONAL ALGEBRA BINARY OPERATION OF DIVISION

CS3319

# STUDENT OBJECTIVES

- Upon completion of this video, you should be able to:
  - Identify the symbol for DIVISION
  - Given 2 tables and a DIVISION relational algebra expression, show the new table that would be returned once the expression is performed.
  - Write a relational algebra expression that uses DIVISION given two tables and a query.

# DIVISION

- $R \div S$  returns a new table that contains:
  - For Columns: only the columns (i.e. attributes) that were in R that were NOT in S
  - For Rows: only the rows (i.e. tuples) from the remaining columns in R that match EVERY SINGLE row in S
- The columns in S MUST be a subset of the columns in R.
- R MUST have more columns than S
- Division can be expressed as:
$$L1 \leftarrow \pi_y(R)$$
$$L2 \leftarrow \pi_y((S \times L1) - R)$$
$$L \leftarrow L1 - L2$$
- Symbol  $\rightarrow \div$
- Example Expression:

**Table1  $\div$  Table2**

First Table Name

Symbol for  
DIVISION

Second Table Name

## Example of Division:

**QUESTION:** What will  $CC \leftarrow AA \div BB$  return?

Table AA:

A	B
a1	b1
a2	b1
a3	b1
a4	b1
a1	b2
a3	b2
a2	b3
a3	b3
a4	b3
a1	b4
a2	b4
a3	b4

Table BB:

A
a1
a2
a3

Table CC:

B
b1
b4

# ANOTHER EXAMPLE

**QUESTION:** What will  $CC \leftarrow AA \div BB$  return?

**Table AA:**

A	B	C	D
dog	2	77	pink
dog	3	77	yellow
cat	2	88	pink
pig	1	77	yellow
pig	5	99	red
cat	1	88	yellow
owl	1	66	yellow
owl	2	77	pink
owl	2	66	pink

**Table BB:**

B	D
1	yellow
2	pink

**Table CC:**

A	C
cat	88
owl	66

- Type of query might be: *Find SSN's of people who work on **all** of Smith's projects*
- Result of:  $SSN\_PNOS \div SMITH\_PNO$

**SSN\_PNOS**

Essn	Pno
123456789	1
123456789	2
666884444	3
453453453	1
453453453	2
333445555	2
333445555	3
333445555	10
333445555	20
999887777	30
999887777	10
987987987	10
987987987	30
987654321	30
987654321	20
888665555	20

**SMITH\_PNOS**

Pno
1
2

**SSNS**

Ssn
123456789
453453453

- Useful for situations where the term "**ALL**" is used, for example:
  - *Find the first and last names of employees who work on **all** the projects that Dave Leno works on.*

the answer would be like this:

**Leno**  $\leftarrow \pi_{\text{EmpID}} (\sigma_{\text{LastName} = \text{"Leno"}} (\text{Employee}))$

**Leno\_Proj**  $\leftarrow \pi_{\text{ProjectNumber}} (\text{Works\_On} \bowtie_{\text{EmpIDSSNum} = \text{EmpID}} \text{Leno})$

**All\_Proj**  $\leftarrow \pi_{\text{EmpIDSSNum}, \text{ProjectNumber}} (\text{Works\_On})$

**LenoPROJ**  $\leftarrow \text{All\_Proj} \div \text{Leno\_Proj}$

**Result**  $\leftarrow \pi_{\text{FirstName}, \text{LastName}} (\text{LenoPROJ} \bowtie \text{Employee})$



**QUESTION:** Write the relational algebra to find the project names of any projects that also have all the employees working on them that work on the project named “Acct6”.

$\text{Acct6} \leftarrow \pi_{\text{ProjectNumber}}(\sigma_{\text{ProjectName}=\text{“Acct6”}}(\text{Project}))$

$\text{Acct6\_Emp} \leftarrow \pi_{\text{EmpSSNum}}(\text{Works\_On} \bowtie \text{Acct6})$

$\text{ProjNums} \leftarrow \pi_{\text{EmpSSNum,ProjectNumber}}(\text{Works\_On})$

$\text{AllAcct6} \leftarrow \text{ProjNums} \div \text{Acct6\_Emp}$

$\text{Result} \leftarrow \pi_{\text{ProjectName}}(\text{AllAcct6} \bowtie \text{Project})$

ProjectNu	ProjectName	ProjLocati	Managing
A1	Accounting Update	Toronto	S7G
A3	Acc3	Springfield	G8H
A6	Acct6	Toronto	S7G
I1	Inventory	Toronto	G8H
I2	Inventory2	London	S7G
P1	Payroll	Springfield	G8H
P2	Payroll2	London	G8H
P3	Payroll3	London	G8H

  

DeptNun	DeptName	ManagerEmpID	ManagerStartdate
G8H	Head Office	4	12/12/1999
S7G	Safety Department	3	11/11/1998
Y5J	Research Department	6	12/24/1998

  

EmpID	LastName	FirstName	DeptNumber	Sex	BDate	SuperSSN	Salary
1	Simpson	Bart	G8H	M	2/2/1995	2	\$1,000.00
2	Smithers	Waylan	S7G	M	1/1/1960	4	\$2,000.00
3	Beauvieu	Patty	Y5J	F	3/3/1959	6	\$4,000.00
4	Burns	Monty	S7G	M	7/7/2020		\$5,000.00
6	Simpson	Lisa	S7G	F	6/6/1990	2	\$1,000.00
12	Simpson	Homer	G8H	M	8/8/1961	2	\$2,000.00

  

EmpSSNu	ProjectNu	Hours
1 A3		45
2 A1		56
3 A3		3
3 A6		45
3 I1		43
3 P1		9
4 A1		6
4 A3		5
4 A6		6
4 I1		43
4 I2		8
4 P1		67
4 P2		77
4 P3		67
6 I2		6
12 A3		56