WEEK 4

THE RELATIONAL ALGEBRA BINARY OPERATION OF CARTESIAN PRODUCT

STUDENT OBJECTIVES

- Upon completion of this video, you should be able to:
  - Write a relational algebra expression that uses CARTESIAN PRODUCT given two tables and a query.
  - Given 2 tables and a CARTESIAN PRODUCT relational algebra expression, show the new table that would be returned once the expression is performed.
  - Determine how many attributes/columns will be in the resulting table when two tables are CARTESIAN PRODUCTED together.
  - Determine how many row will be in the resulting table when two tables are CARTESIAN PRODUCTED together.
  - Identify patterns in a CARTESIAN PRODUCT resulting table will help determine the answer to queries.

CARTESIAN PRODUCT

no need to be union compatible.

- Creates a new table from the given 2 tables where every row in the new table is a match of each row from each table.
- The new table will have all the attributes of the first table AND all the attributes of the second table
- The new table's number of rows will equal first table's number of rows * the second table's number of rows.
- Symbol → **X**
- Example Expression:

Table1 X Table2

Table1

ID	FirstName	LastName	Age
12	Homer	Smith	24
24	Gene	Simpson	13
45	Walter	Reid	45

Table2

ID	FirstName	LastName	Age
33	Marg	Jones	28
24	Gene	Simpson	13

ANSWER

ID	FirstName	LastName	Age	Table2.ID	Table2.FirstName	Table2.LastName	Table2.Age
12	Homer	Smith	24	33	Marg	Jones	28
24	Gene	Simpson	13	33	Marg	Jones	28
45	Walter	Reid	45	33	Marg	Jones	28
12	Homer	Smith	24	24	Gene	Simpson	13
24	Gene	Simpson	13	24	Gene	Simpson	13
45	Walter	Reid	45	24	Gene	Simpson	13

Example of Cartesian Product:

Table AA:

A	*B*	*C*
11	Pig	Cat
22	Dog	Cat

Table BB:

A	*D*
Horse	11
Pig	22
Pig	33

AA X BB

AA.A	*B*	*C*	*BB.A*	*D*
11	Pig	Cat	Horse	11
22	Dog	Cat	Horse	11
11	Pig	Cat	Pig	22
22	Dog	Cat	Pig	22
11	Pig	Cat	Pig	33
22	Dog	Cat	Pig	33

Department X Project:

Query1

DeptNumbe	DeptName	ManagerEn	ManagerStartdate	ProjectNumbe	ProjectName	ProjLocation	ManagingDeptNu
G8H	Head Office	4	12/12/1999	A1	Accounting Update	Toronto	S7G
S7G	Safety Department	3	11/11/1998	A1	Accounting Update	Toronto	S7G
Y5J	Research Department	6	12/24/1998	A1	Accounting Update	Toronto	S7G
G8H	Head Office	4	12/12/1999	A3	Acc3	Springfield	G8H
S7G	Safety Department	3	11/11/1998	A3	Acc3	Springfield	G8H
Y5J	Research Department	6	12/24/1998	A3	Acc3	Springfield	G8H
G8H	Head Office	4	12/12/1999	A6	Acct6	Toronto	S7G
S7G	Safety Department	3	11/11/1998	A6	Acct6	Toronto	S7G
Y5J	Research Department	6	12/24/1998	A6	Acct6	Toronto	S7G
G8H	Head Office	4	12/12/1999	I1	Inventory	Toronto	G8H
S7G	Safety Department	3	11/11/1998	I1	Inventory	Toronto	G8H
Y5J	Research Department	6	12/24/1998	I1	Inventory	Toronto	G8H
G8H	Head Office	4	12/12/1999	I2	Inventory2	London	S7G
S7G	Safety Department	3	11/11/1998	I2	Inventory2	London	S7G
Y5J	Research Department	6	12/24/1998	I2	Inventory2	London	S7G
G8H	Head Office	4	12/12/1999	P1	Payroll	Springfield	G8H
S7G	Safety Department	3	11/11/1998	P1	Payroll	Springfield	G8H
Y5J	Research Department	6	12/24/1998	P1	Payroll	Springfield	G8H
G8H	Head Office	4	12/12/1999	P2	Payroll2	London	G8H
S7G	Safety Department	3	11/11/1998	P2	Payroll2	London	G8H
Y5J	Research Department	6	12/24/1998	P2	Payroll2	London	G8H
G8H	Head Office	4	12/12/1999	P3	Payroll3	London	G8H
S7G	Safety Department	3	11/11/1998	P3	Payroll3	London	G8H
Y5J	Research Department	6	12/24/1998	P3	Payroll3	London	G8H

QUESTION: How many tuples are above?

How many columns/attributes are there?

Where did those numbers come from?

3 x 8

8

row : *

clm : +

Department X Project:

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

Record: 8 of 8 No Filter Search

WorksOn

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

Record: 1 of 16 No Filter Search

Department

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

Record: 1 of 3 No Filter Search

Employee

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	Beauvieau	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

QUESTION: What would the following relational algebra expression result in?

Temp1 (LastName, FN)← π LastName, FirstName (σ EmpID > 4 (Employee))

Temp2 ← π FirstName, Salary, Sex (σ Sex = "M" (Employee))

Result ← Temp1 X Temp2

Employee

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	Beauvieau	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
0						0	$0.00

Temp1

LastName	FN
Simpson	Lisa
Simpson	Homer

Temp2

FirstName	Salary	Sex
Bart	1000	M
Waylan	2000	M
Monty	5000	M
Homer	2000	M

Result

LastName	FN	Firstname	Salary	Sex
Simpson	Lisa	Bart	$1,000.00	M
Simpson	Homer	Bart	$1,000.00	M
Simpson	Lisa	Waylan	$2,000.00	M
Simpson	Homer	Waylan	$2,000.00	M
Simpson	Lisa	Monty	$5,000.00	M
Simpson	Homer	Monty	$5,000.00	M
Simpson	Lisa	Homer	$2,000.00	M
Simpson	Homer	Homer	$2,000.00	M

QUESTION: What would the following relational algebra expression result in?

Temp1 ← π DeptName, ManagerEmpID (Department)

Temp2 ← π LastName, FirstName, EmpID (Employee)

Result ← Temp2 X Temp1

Temp1

DeptName	ManagerEmpID
Head Office	4
Safety Department	3
Research Department	6

Temp2

LastName	FirstName	EmpID
Simpson	Bart	1
Smithers	Waylan	2
Beauvieau	Patty	3
Burns	Monty	4
Simpson	Lisa	6
Simpson	Homer	12

Result

DeptName	ManagerEmpID	LastName	FirstName	EmpID
Head Office	4	Simpson	Bart	1
Safety Department	3	Simpson	Bart	1
Research Department	6	Simpson	Bart	1
Head Office	4	Smithers	Waylan	2
Safety Department	3	Smithers	Waylan	2
Research Department	6	Smithers	Waylan	2
Head Office	4	Burns	Monty	4
Safety Department	3	Burns	Monty	4
Research Department	6	Burns	Monty	4
Head Office	4	Simpson	Lisa	6
Safety Department	3	Simpson	Lisa	6
Research Department	6	Simpson	Lisa	6
Head Office	4	Beauvieau	Patty	3
Safety Department	3	Beauvieau	Patty	3
Research Department	6	Beauvieau	Patty	3
Head Office	4	Simpson	Homer	12
Safety Department	3	Simpson	Homer	12
Research Department	6	Simpson	Homer	12

Record: 1 of 18 No Filter Search

QUESTION: Do you notice any patterns in the resulting relationship (Hint: Look for attributes that are equal)

what is cartesian product used for?
=> to find information across tables.
i.e. MEID = EMPID
=> this person is manager of the dept.

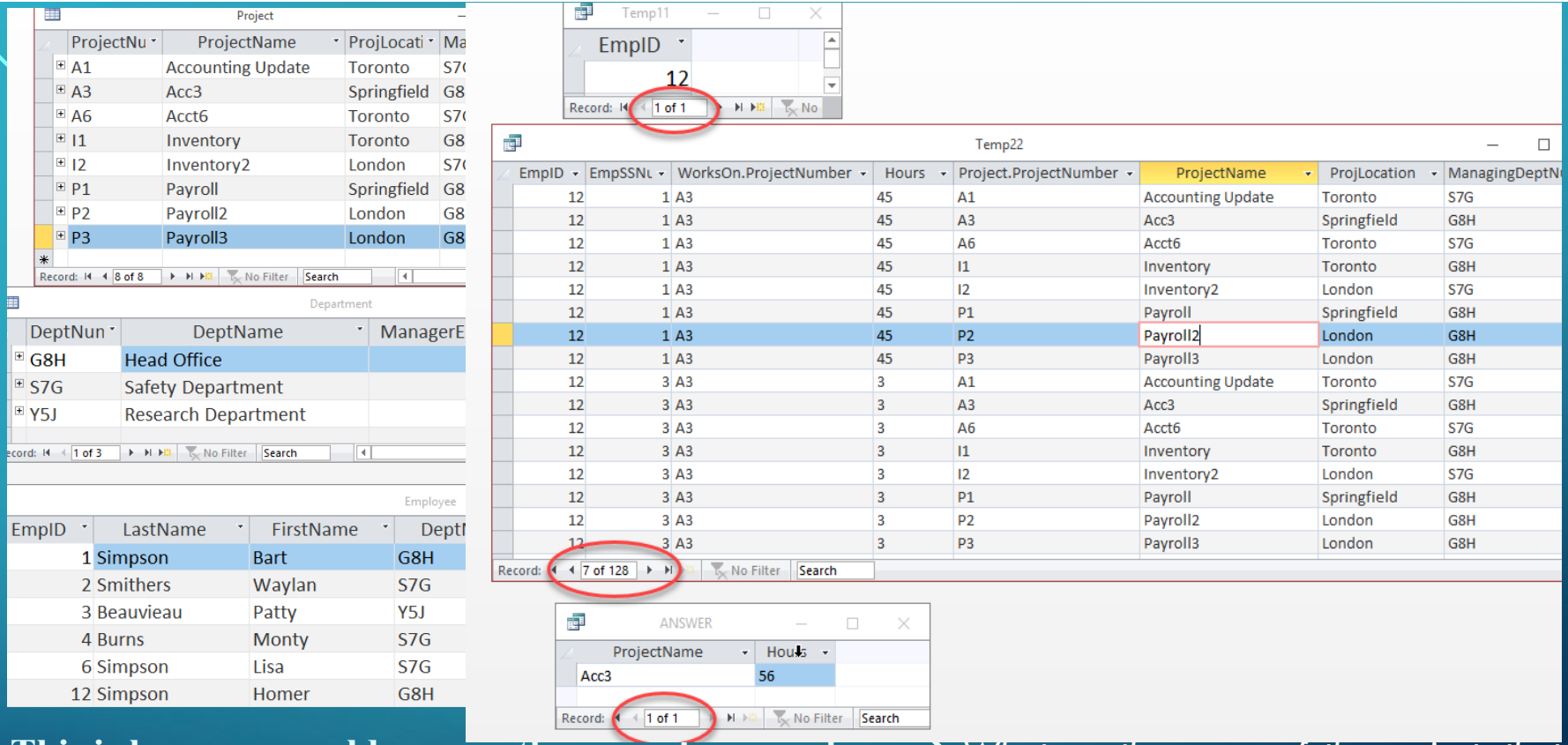
Result

DeptName	ManagerEmpID	LastName	FirstName	EmpID
Head Office	4	Simpson	Bart	1
Safety Department	3	Simpson	Bart	1
Research Department	6	Simpson	Bart	1
Head Office	4	Smithers	Waylan	2
Safety Department	3	Smithers	Waylan	2
Research Department	6	Smithers	Waylan	2
Head Office	4	Burns	Monty	4
Safety Department	3	Burns	Monty	4
Research Department	6	Burns	Monty	4
Head Office	4	Simpson	Lisa	6
Safety Department	3	Simpson	Lisa	6
Research Department	6	Simpson	Lisa	6
Head Office	4	Beauvieau	Patty	3
Safety Department	3	Beauvieau	Patty	3
Research Department	6	Beauvieau	Patty	3
Head Office	4	Simpson	Homer	12
Safety Department	3	Simpson	Homer	12
Research Department	6	Simpson	Homer	12

Record: 1 of 18 | No Filter | Search

QUESTION: Suppose I asked you to give me the name of the managers of the departments and their department names, how could you use the above result to answer my query (question)?

Temp1 ← π FirstName,LastName, EmpID (Employee)
Temp2 ← π DeptName,ManagerEmpID (Department)
Temp3 ← (Temp1 X Temp2)
ANSWER ← π FirstName,LastName, DeptName ($\sigma_{EmpID=ManagerEmpID}$(Temp3))



This is how you would answer the second query above → *What are the names of the projects that Homer work on, and for how long on each?*

Temp11← $\pi_{\text{EmpID}}(\sigma_{\text{FirstName="Homer"}}(\text{Employee}))$

Temp22← $(\text{Temp1} \times \text{WorksOn} \times \text{Project})$

ANSWER← $\pi_{\text{Project.ProjectName,Hours}}(\sigma_{(\text{EmpID=EmpSSNum AND WorksOn.ProjectNum=Project.ProjectNum})}(\text{Temp22}))$