

WEEK 4

THE RELATIONAL ALGEBRA BINARY OPERATION OF INNER JOIN (NATURAL JOIN AND EQUI JOIN)

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STUDENT OBJECTIVES

- Upon completion of this video, you should be able to:
 - Identify the symbols for natural join and equi join.
 - Determine if the join will be possible based on the given tables and join information.
 - Write a relational algebra expression that uses JOINS given two tables based on a given query.
 - Given 2 tables and a JOIN relational algebra expression, show the new table that would be returned once the expression is performed.
 - Given a JOIN relational algebra expression and two tables, explain in simple English what query is answered by the expression.

- \bullet A join is just a Cartesian Product X with a Selection σ to find matches. The selection will remove some of the rows/tuples from the returned Cartesian Product.
 - Table 1
- The attributes that will be in the new table depends putifyou are doing an equi join or a natural join
- Symbol → 🔀
- Example Expression:

Table1 ⋈ Table2 (natural join)

Table1 ⋈

columnnametable1=columnnametable2 Table2 (equi join)

ANSWER FOR Table1 ⋈ Table2

First Table Name

ANSWER FOR Table1 ⋈ Age=ID Table2

Symbol for Join and maybe a subscript saying which column to join on.

Second Table Name

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• A join is just a Cartesian Product X with a Selection σ to find matches. The selection will remove some of the rows/tuples from the returned Cartesian Product.

• T	ID	FirstName	LastName	Age
	12	Homer	Smith	24
• s	24	Gene	Simpson	33
	45	Walter	Reid	33

pends pulifeyou are doing an equi join or a natural join

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

• Example Expression:

Table1 ⋈ Table2 (natural join)

Table1 ⋈

columnnametable1=columnnametable2 Table2 (equi join)

ANSWER FOR Table1 ⋈ Age=ID Table2

ANSWER FOR Table 1 ⋈ Table 2

Symbol for Join and maybe a subscript

ID	FirstName	LastName	Age	Table2.ID	Table2.FirstName	Table 2. Last Name	
12	Homer	Smith	24	24	Gene	Simpson	13
24	Gene	Simpson	33	33	Marg	Jones	28
45	Walter	Reid	33	33	Marg	Jones	28

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MORE ON JOINS

- R \bowtie Boolean formula S: Produces a relation that contains tuples satisfying a condition from the Cartesian Product of R X S where the formula can contain comparisons using one of <,<=,>,>=,=,<> connected by and, or and not
- Example:

Department ⋈ ManagerSSN = SuperSSN Employee

Staff ⋈ Salary > Salary and JobLevel=JobLevel Manager

NATURAL JOIN MORE INFO:

- If the two tables being joined have the same attribute name(s), it is a natural join and the attribute will only show up ONCE in the resulting table
- The natural join includes EACH pair of attributes with the same name, "AND" ed together, for example:
 - $Q \leftarrow R(A,B,C,D) \bowtie S(C,D,E)$
 - Result would only keep one copy of each pair
 - R.C=S.C AND R.D = S.D
 - and would give: Q(A,B,C,D,E)

- **Equi Join:** when all of the comparisons are =, then it is called an equi join and pairs of the attributes are returned that are equal (i.e. attribute from both sides of the equals are returned).
- Natural Join: when all of the comparisons are = and it matches any attribute in Table 1 that has the same name as the attribute in Table 2. The attribute is only shown once.

Tabl	e1						A			Abo				ala ITs	dh	402	T.	ah	101
Α	В	С	D		A	В		С	D		16.3	XE					D	AU.	ie i
7	Cow	Pink	22		7	Со	W	Pink	22										
8	Dog	Pink	33	1	8	Do	g	Pink	33	F	D	le	2.A	E	Tak	ole2.C	F		Table2.D
9	Cow	Red	44	8	9	Со	W	Red	44	Shoe	44			Cow	Pir	ık	Shoe	е	44
	-0			8	3	7	8	Cat	Pink	Hat	33			Cat	Pir	ık	Hat		33
Tabl	eZ E	C	F	D		8		Dog	Pink	33	8	3		Cow	Pir	ık	Shoe	Э	44
			-			8	Α	В	С	D	Tal	ble1.	.А	Table1.B		Table1	.c	Tab	le1.D
6	Cow	Blue	Hat	3	3		7	Cow	Pink	22	8			Dog		Pink		33	
6	Cow	Blue	Sock	4	4		7	Cow	Pink	22	9			Cow		Red		44	
8	Cow	Pink	Shoe	4	4														
8	Cat	Pink	Hat	3	3		ð	род	PINK	33	9			Cow		кеа		44	
	Cow Cow		Hat Sock	3	4	8						ble1.	.A				.c		le1

MORE REALISTIC EXAMPLES OF JOINS:

Example 1:

Equi Join on Department and Project:

Project ⋈ Project.DeptNumber = Department.DeptNumber Department

	ProjectName	ProjectNumb	ProjectLocation	project.DeptNum	Department.DeptNun	DeptName	ManagerS
·	Accounting Upd	A1	Toronto	S7G	S7G	Safety Department	
	Inventory2	12	London	S7G	S7G	Safety Department	
	Acct6	A6	Toronto	S7G	S7G	Safety Department	
	Payroll	P1	Springfield	G8H	G8H	Head Office	
	Acc3	A3	Springfield	G8H	G8H	Head Office	
	Payroll2	P2	London	G8H	G8H	Head Office	
	Payroll3	P3	London	G8H	G8H	Head Office	
	Inventory	l1	Toronto	G8H	G8H	Head Office	

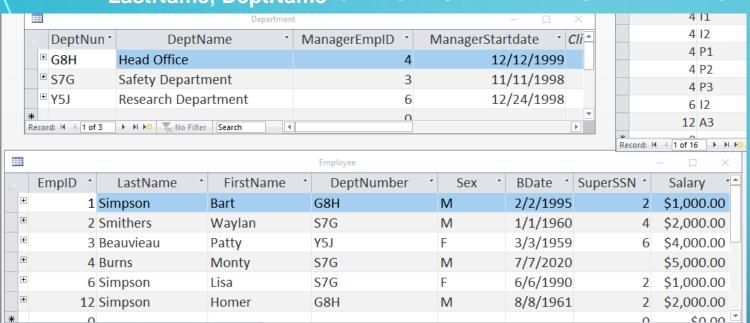
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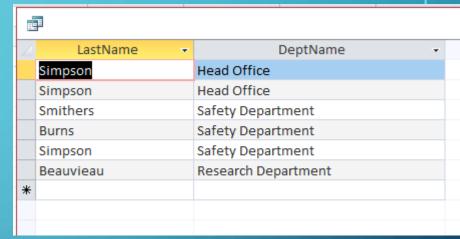
Example 2: Natural Join on Department and Project: Project ⋈ Department

	ProjectName	ProjectNumb	ProjectLocation	Department.DeptNun	DeptName	ManagerSSN	ManagerS
•	Accounting Upd	A1	Toronto	S7G	Safety Department	3	
	Inventory2	12	London	S7G	Safety Department	3	
	Acct6	A6	Toronto	S7G	Safety Department	3	
	Payroll	P1	Springfield	G8H	Head Office	4	
	Acc3	A3	Springfield	G8H	Head Office	4	
	Payroll2	P2	London	G8H	Head Office	4	
	Payroll3	P3	London	G8H	Head Office	4	
	Inventory	l1	Toronto	G8H	Head Office	4	

QUESTION: What will be the resulting table of the following relational algebra expression?

π _{LastName}, _{DeptName} (Employee ⋈ Department)





QUESTION: What does the above result represent in English?

ANSWER: Show me all the Employee's last names and the name of the Department that they have been assigned to.

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QUESTION: What will be the difference that will result in the answers in the following two relation algebra expressions?

Expression 1: Employee ⋈ Department

Expression 2: Employee ⋈ _{DeptNumber = DeptNumber} Department

	DeptNumber	DeptName ▼	ManagerEmpID 🕶	ManagerStartdate +	EmpID → LastName	→ FirstName	Sex -	BDate -	SuperSSN -	Salary -
	G8H	Head Office	4	12/12/1999	1 Simpson	Bart	M	2/2/1995	2	\$1,000.00
	G8H	Head Office	4	12/12/1999	12 Simpson	Homer	M	8/8/1961	2	\$2,000.00
	S7G	Safety Department	3	11/11/1998	2 Smithers	Waylan	M	1/1/1960	4	\$2,000.00
	S7G	Safety Department	3	11/11/1998	4 Burns	Monty	M	7/7/2020		\$5,000.00
	\$7G	Safety Department	3	11/11/1998	6 Simpson	Lisa	F	6/6/1990	2	\$1,000.00
	Y5J	Research Department	6	12/24/1998	3 Beauvieau	Patty	F	3/3/1959	6	\$4,000.00
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Ш	Department.DeptNumber -	DeptName 🔻	ManagerEmpID	ManagerStartdate -	EmpID - LastName	FirstName	 Employee.DeptNumber 	Sex -	BDate -	SuperSSN -	Salary -
Ш	G8H	Head Office		4 12/12/1999	1 Simpson	Bart	G8H	M	2/2/1995	2	\$1,000.00
Ш	G8H	Head Office		12/12/1999	12 Simpson	Homer	G8H	M	8/8/1961	2	\$2,000.00
Ш	\$7G	Safety Department		11/11/1998	2 Smithers	Waylan	S7G	M	1/1/1960	4	\$2,000.00
Ш	S7G	Safety Department		11/11/1998	4 Burns	Monty	S7G	M	7/7/2020		\$5,000.00
Ш	S7G	Safety Department		11/11/1998	6 Simpson	Lisa	S7G	F	6/6/1990	2	\$1,000.00
	Y5J	Research Department		12/24/1998	3 Beauvieau	Patty	Y5J	F	3/3/1959	6	\$4,000.00
	*										

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QUESTION: What will the following expression return?

Temp(LN, FN, SSN) $\leftarrow \pi_{LastName,FirstName,EmpID}$ (Employee)

 $Result \leftarrow \text{Temp} \bowtie_{\text{SSN=SuperSSN}} (\pi_{\text{LastName,FirstName,SuperSSN,EmpID}} (\text{Employee}))$

LN	*	FN	*	SSN	*
Simpson	В	art			1
Smithers	٧	Vaylan			2
Beauvieau	P	atty			3
Burns	N	/lonty			4
Simpson	L	isa			6
Simpson	H	lomer			12
					0



/	LN ▼	FN -	SSN +	LastName →	FirstName •	SuperSSN +	EmpID →
	Smithers	Waylan	2	Simpson	Bart	2	1
	Smithers	Waylan	2	Simpson	Lisa	2	6
	Smithers	Waylan	2	Simpson	Homer	2	12
	Burns	Monty	4	Smithers	Waylan	4	2
	Simpson	Lisa	6	Beauvieau	Patty	6	3

QUESTION: In English, what does the above expression represent?

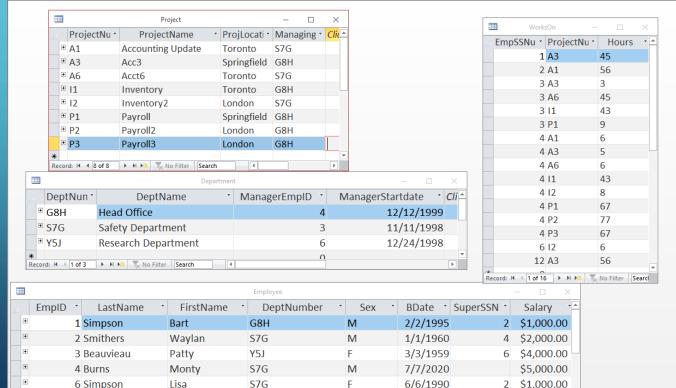
ANSWER: Show me the id and first and last names of the supervisors and the ids and first and last names of the employees that they supervise.

QUESTION: Write the Relational Algebra expression to print the department name, and the manager's first and last name:

π DeptName, LastName, FirstName (Employee ⋈ Emplo = ManagerEmplo Department)

QUESTION: Write the Relational Algebra expression to display department names of departments who have people making more than 4,000 dollars.

TEMP $\leftarrow \pi$ DeptNumber (σ Salary > 4000 (Employee)) ANSWER $\leftarrow \pi$ DeptName (TEMP \bowtie Department)



QUESTION: Write the Relational Algebra expression to print the first and last name of all employees, the name of the projects they work on and the number of hours they work on each project. (This is a join for a many to many relationship)

TEMP ← π FirstName, LastName, ProjectNumber, Hours (EMPLOYEE ⋈

EmpID=EmpSSNNumberWORKSON)

ANSWER ← π FirstName, LastName, Ho

OR

ANSWER ← π FirstName, LastName, Hours, Project PROJECT)

