WEEK 4

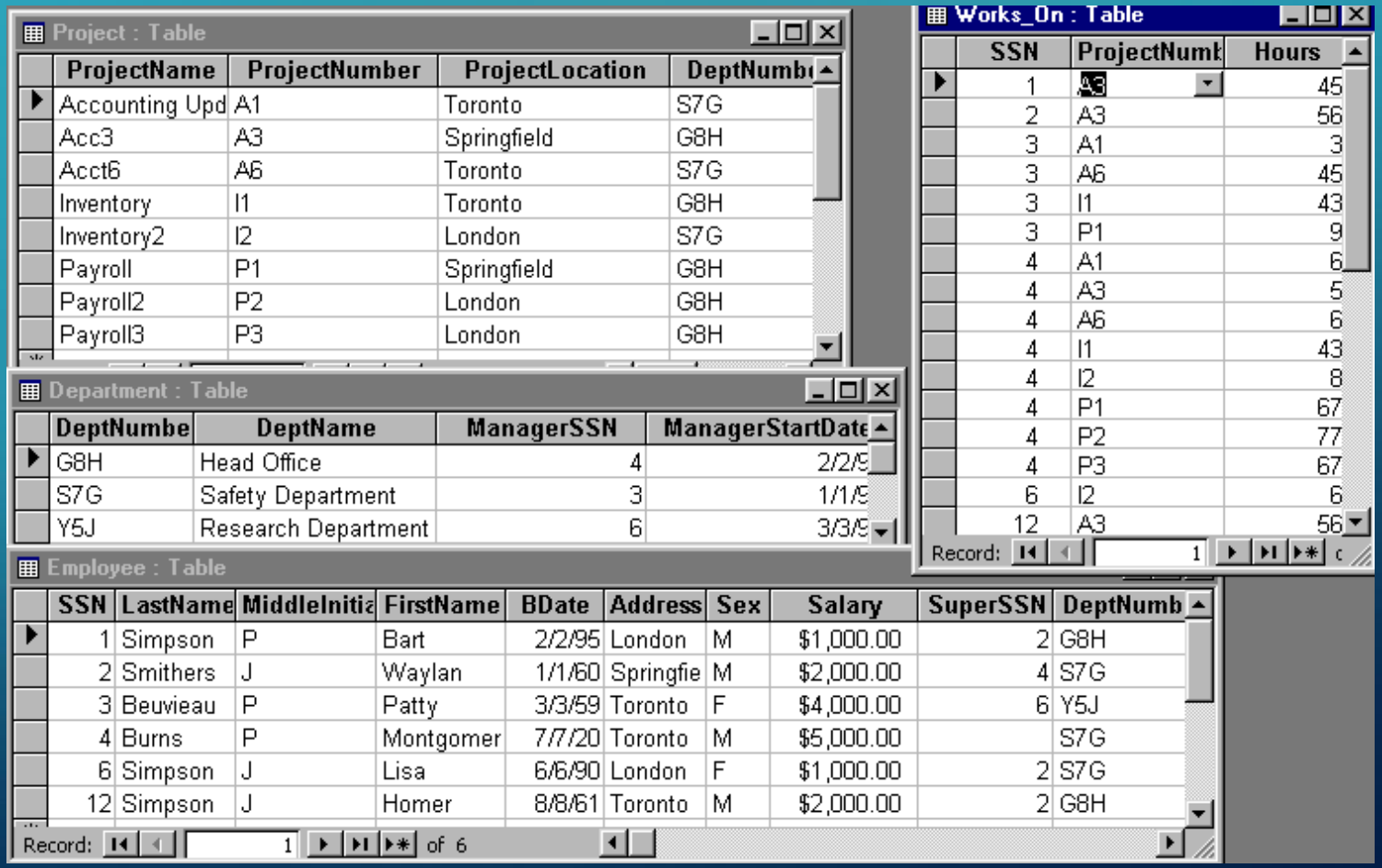
THE RELATIONAL ALGEBRA UNARY OPERATIONS OF PROJECTION AND SELECTION

STUDENT OBJECTIVES

- Upon completion of this video, you should be able to:
  - Write a relational algebra expression that uses SELECTION given a table and a query.
  - Given a table and a SELECTION relational algebra expression, show the new table that would be returned once the expression is performed on the table.
  - Write a relational algebra expression that uses PROJECTION given a table and a query.
  - Given a table and a PROJECTION relational algebra expression, show the new table that would be returned once the expression is performed on the table.
  - Write an expression that renames an attribute
  - Break an expression down so that it creates temporary tables that are used as input to the next expression

EXAMPLES OF PROJECTION & SELECTION

- Using the following data:



Project : Table

ProjectName	ProjectNumber	ProjectLocation	DeptNumbe
Accounting Upd	A1	Toronto	S7G
Acc3	A3	Springfield	G8H
Acct6	A6	Toronto	S7G
Inventory	I1	Toronto	G8H
Inventory2	I2	London	S7G
Payroll	P1	Springfield	G8H
Payroll2	P2	London	G8H
Payroll3	P3	London	G8H

Works_On : Table

SSN	ProjectNumb	Hours
1	A3	45
2	A3	56
3	A1	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

Department : Table

DeptNumbe	DeptName	ManagerSSN	ManagerStartDate
G8H	Head Office	4	2/2/9
S7G	Safety Department	3	1/1/9
Y5J	Research Department	6	3/3/9

Employee : Table

SSN	LastName	MiddleInitia	FirstName	BDate	Address	Sex	Salary	SuperSSN	DeptNumb
1	Simpson	P	Bart	2/2/95	London	M	$1,000.00	2	G8H
2	Smithers	J	Waylan	1/1/60	Springfie	M	$2,000.00	4	S7G
3	Beuvieau	P	Patty	3/3/59	Toronto	F	$4,000.00	6	Y5J
4	Burns	P	Montgomer	7/7/20	Toronto	M	$5,000.00		S7G
6	Simpson	J	Lisa	6/6/90	London	F	$1,000.00	2	S7G
12	Simpson	J	Homer	8/8/61	Toronto	M	$2,000.00	2	G8H

Record: 1 of 6

SELECTION

- Create a new table from a given table and in that new table return only the **rows** that satisfy a given condition
- Symbol → σ
- Example Expression:

$$\sigma_{\text{Age} > 30}(\text{EMPLOYEE})$$

Symbol for Selection

Condition that each row must satisfy to be returned in the answer

Table Name

condition could contain and/or.

EMPLOYEE

ID	FirstName	LastName	Age
12	Homer	Smith	24
24	Gene	Simpson	13
45	Walter	Reid	45
47	William	Reid	87
78	Ben	Cooker	14

ANSWER

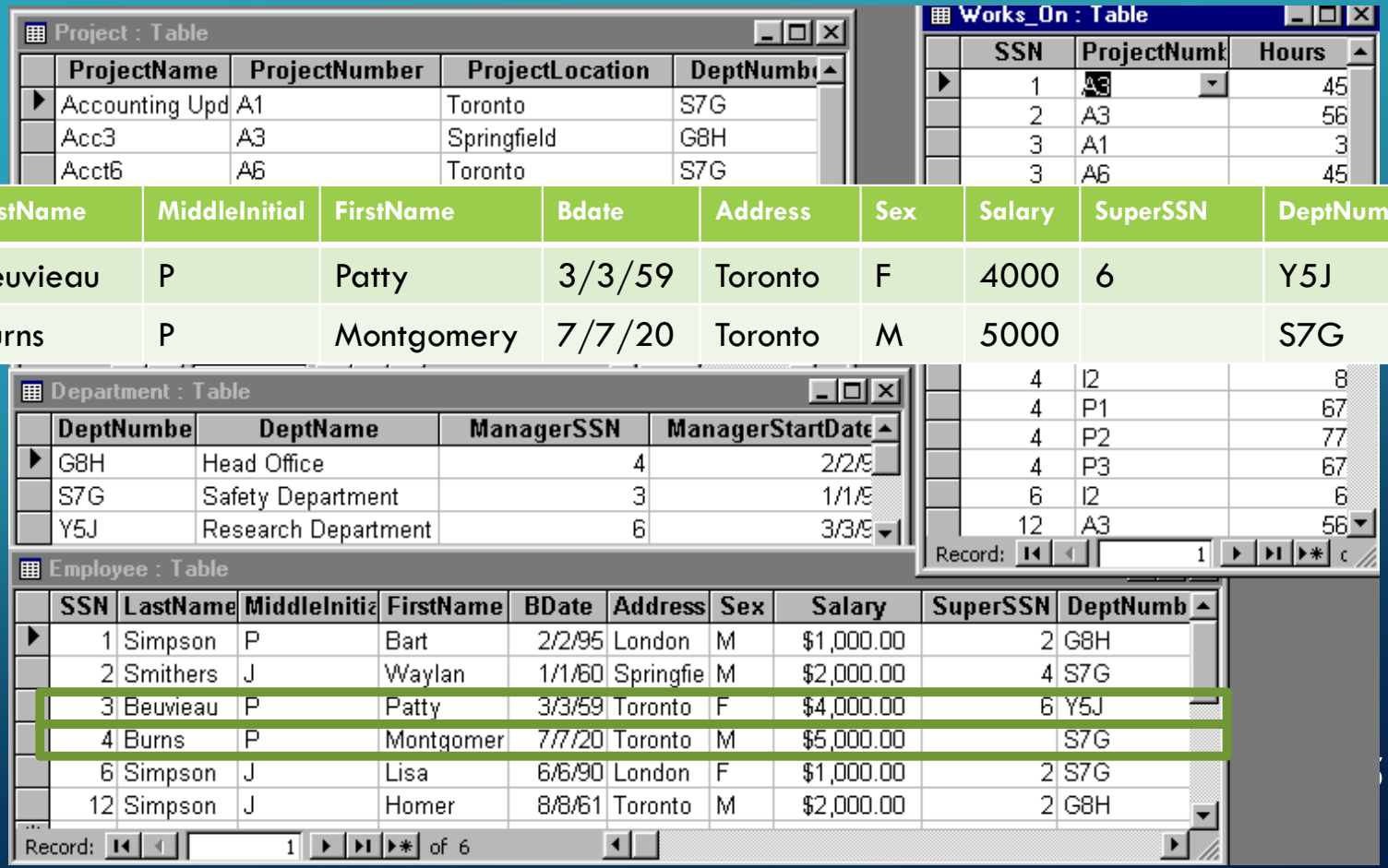
ID	FirstName	LastName	Age
45	Walter	Reid	45
47	William	Reid	87

- QUESTION: What would be returned with the expression:

$$\sigma_{\text{Salary} > 3000}(\text{Employee})$$

ANSWER

SSN	LastName	MiddleInitial	FirstName	Bdate	Address	Sex	Salary	SuperSSN	DeptNum
3	Beuvieau	P	Patty	3/3/59	Toronto	F	4000	6	Y5J
4	Burns	P	Montgomery	7/7/20	Toronto	M	5000		S7G



- QUESTION: What would be returned with the expression:

$\sigma_{\text{Salary} > 3000}(\text{Employee})$

ANSWER

SSN	LastName	MiddleInitial	FirstName	Bdate	Address	Sex	Salary	SuperSSN	DeptNum
3	Beuvieau	P	Patty	3/3/59	Toronto	F	4000	6	Y5J
4	Burns	P	Montgomery	7/7/20	Toronto	M	5000		S7G

- The above rewritten as an English question would be:

Find all the employee information about employees who make a salary greater than 3000.

This is called a **QUERY**

1, relation algebra

2- results.

PROJECTION

- Create a new table from a given table and in that new table return only the **COLUMNS** that satisfy a given condition

- Symbol → π

- Example Expression:

$$\pi_{\text{Age,LastName}}(\text{EMPLOYEE})$$

Symbol for Projection

The Columns (Attributes) that should be returned

Table Name

EMPLOYEE

ID	FirstName	LastName	Age
12	Homer	Smith	24
24	Gene	Simpson	13
45	Walter	Reid	45
47	William	Reid	87
78	Ben	Cooker	14

ANSWER

Age	LastName
24	Smith
13	Simpson
45	Reid
87	Reid
14	Cooker

QUESTION: What would be returned with the expression:

$$\pi_{\text{LastName, FirstName}}(\text{Employee})$$

ANSWER

LastName	FirstName
Simpson	Bart
Smithers	Waylan
Beuieau	Patty
Burns	Montgomery
Simpson	Lisa
Simpson	Homer

Project : Table

ProjectName	ProjectNumber	ProjectLocation	DeptNumb
Accounting Upd	A1	Toronto	S7G
Acc3	A3	Springfield	G8H
Acct6	A6	Toronto	S7G
Inventory	I1	Toronto	G8H
Inventory2	I2	London	S7G
Payroll	P1	Springfield	G8H
Payroll2	P2	London	G8H
Payroll3	P3	London	G8H

Works_On : Tabl

SSN	Proj
1	A3
2	A3
3	A1
3	A6
3	I1
3	P1
4	A1
4	A3
4	A6
4	I1
4	I2
4	P1
4	P2
4	P3
6	I2
12	A3

Record: 1

Department : Table

DeptNumbe	DeptName	ManagerSSN	ManagerStartDate
G8H	Head Office	4	2/2/9
S7G	Safety Department	3	1/1/9
Y5J	Research Department	6	3/3/9

Employee : Table

SSN	LastNam	MiddleIniti	FirstName	BDate	Address	Sex	Salary	SuperSSN	DeptNumb
1	Simpson	P	Bart	2/2/95	London	M	$1,000.00	2	G8H
2	Smithers	J	Waylan	1/1/60	Springfie	M	$2,000.00	4	S7G
3	Beuvieau	P	Patty	3/3/59	Toronto	F	$4,000.00	6	Y5J
4	Burns	P	Montgomer	7/7/20	Toronto	M	$5,000.00		S7G
6	Simpson	J	Lisa	6/6/90	London	F	$1,000.00	2	S7G
12	Simpson	J	Homer	8/8/61	Toronto	M	$2,000.00	2	G8H

Record: 1

QUESTION: What would be returned with the expression:

$$\pi_{\text{LastName, FirstName}} (\text{Employee})$$

ANSWER

LastName	FirstName
Simpson	Bart
Smithers	Waylan
Beuieau	Patty
Burns	Montgomery
Simpson	Lisa
Simpson	Homer

QUESTION: Rewrite the question above as a query (English Question):

ANSWER: Give me just the first name and last name of all the employees.

QUESTION: Write the expression to find all project information about projects located in Toronto or London:

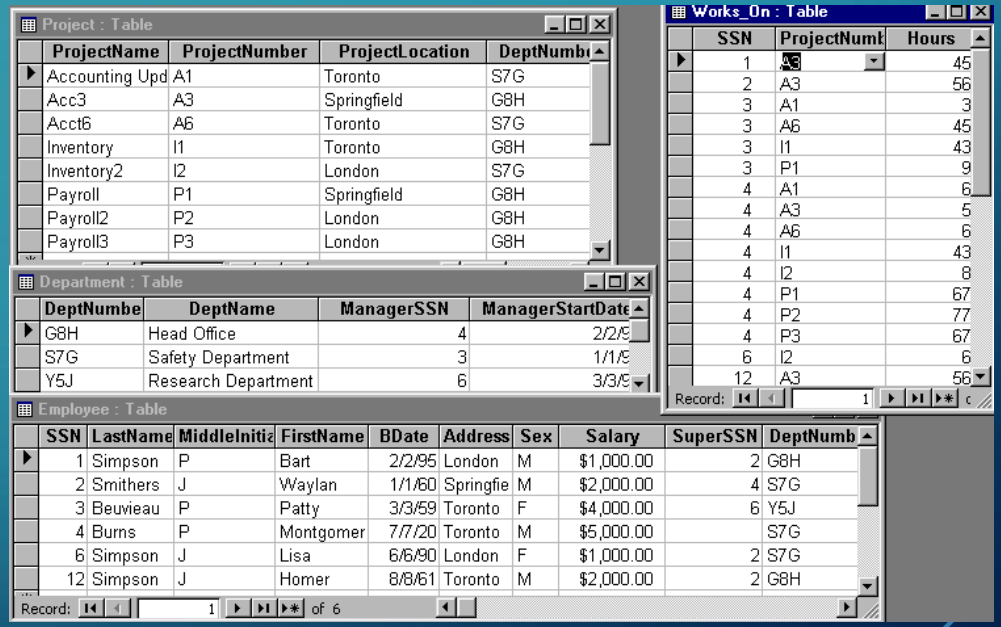
$$\sigma_{(\text{ProjectLocation} = \text{'Toronto'} \text{ or } \text{ProjectLocation} = \text{'London'})}(\text{Project})$$

QUESTION: Write the expression to find all department names:

$$\pi_{\text{DeptName}}(\text{Department})$$

QUESTION: Write the expression to find the address and first name of male employees:

$$\pi_{\text{Address,FirstName}}(\sigma_{(\text{Sex}=\text{'M'})}(\text{Employee}))$$



Project : Table

ProjectName	ProjectNumber	ProjectLocation	DeptNumb
Accounting Upd	A1	Toronto	S7G
Acc3	A3	Springfield	G8H
Acct6	A6	Toronto	S7G
Inventory	I1	Toronto	G8H
Inventory2	I2	London	S7G
Payroll	P1	Springfield	G8H
Payroll2	P2	London	G8H
Payroll3	P3	London	G8H

Works_On : Table

SSN	ProjectNumb	Hours
1	A3	45
2	A3	56
3	A1	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

Department : Table

DeptNumbe	DeptName	ManagerSSN	ManagerStartDate
G8H	Head Office	4	2/2/9
S7G	Safety Department	3	1/1/9
Y5J	Research Department	6	3/3/9

Employee : Table

SSN	LastName	MiddleInitia	FirstName	BDate	Address	Sex	Salary	SuperSSN	DeptNumb
1	Simpson	P	Bart	2/2/95	London	M	$1,000.00	2	G8H
2	Smithers	J	Waylan	1/1/60	Springfie	M	$2,000.00	4	S7G
3	Beuvieau	P	Patty	3/3/59	Toronto	F	$4,000.00	6	Y5J
4	Burns	P	Montgomer	7/7/20	Toronto	M	$5,000.00		S7G
6	Simpson	J	Lisa	6/6/90	London	F	$1,000.00	2	S7G
12	Simpson	J	Homer	8/8/61	Toronto	M	$2,000.00	2	G8H

Record: 1 of 6

SEQUENCE OF OPE

- Building Temporary Tables
  - Can break a series of opera relations

Employee : Table

SSN	LastName	MiddleInitia	FirstName	BDate	Address	Sex	Salary	SuperSSN	DeptNumb
1	Simpson	P	Bart	2/2/95	London	M	$1,000.00	2	G8H
2	Smithers	J	Waylan	1/1/60	Springfie	M	$2,000.00	4	S7G
3	Beuvieau	P	Patty	3/3/59	Toronto	F	$4,000.00	6	Y5J
4	Burns	P	Montgomer	7/7/20	Toronto	M	$5,000.00		S7G
6	Simpson	J	Lisa	6/6/90	London	F	$1,000.00	2	S7G
12	Simpson	J	Homer	8/8/61	Toronto	M	$2,000.00	2	G8H

Record: 1 of 6

Example: The following expression:

$\pi_{\text{LastName, Sex}} (\sigma_{\text{BDate} > 1/1/70} (\text{Employee}))$

Can be broken down into:

$\text{Temp1} \leftarrow \sigma_{\text{BDate} > 1/1/70} (\text{Employee})$

$\text{Temp2} \leftarrow \pi_{\text{LastName, Sex}} (\text{Temp1})$

Temp2

LastName	Sex
Simpson	M
Simpson	F

Temp1

SSN	LastName	MiddleInitial	FirstName	Bdate	Address	Sex	Salary	SuperSSN	DeptNum
1	Simpson	P	Bart	2/2/95	London	M	1000	2	G8H
6	Simpson	J	Lisa	6/6/90	London	F	1000	2	S7G

- Renaming Attributes:
  - You may need to rename attributes to make the names easier to understand and occasionally you MUST rename attributes when performing union and joins.

Example:

$$\text{TempTabA}_{(\text{LName, MorF})} \leftarrow \pi_{\text{LastName, Sex}} (\text{Temp2})$$

Temp2

LastName	Sex
Simpson	M
Simpson	F

TempTabA

Lname	MorF
Simpson	M
Simpson	F

QUESTION: Are these the same? YES or NO?

order matters!

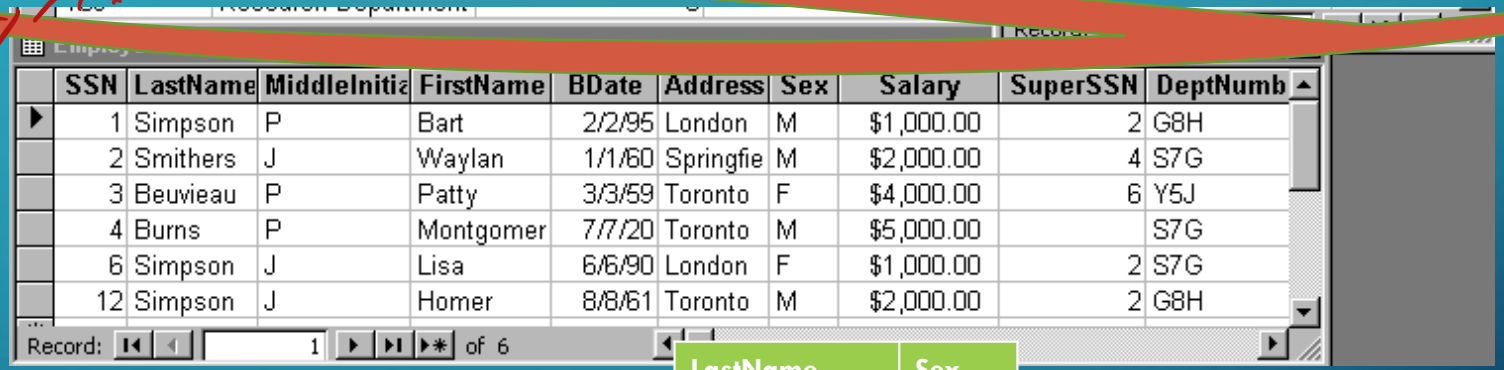
valid

TableA → π LastName, Sex (σ Bdate > 1/1/70 (Employee))

invalid

TableB → σ Bdate > 1/1/70 (π LastName, Sex (Employee))

no birthday here



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2	Smithers	J	Waylan	1/1/60	Springfie	M	$2,000.00	4	S7G
3	Beuvieau	P	Patty	3/3/59	Toronto	F	$4,000.00	6	Y5J
4	Burns	P	Montgomer	7/7/20	Toronto	M	$5,000.00		S7G
6	Simpson	J	Lisa	6/6/90	London	F	$1,000.00	2	S7G
12	Simpson	J	Homer	8/8/61	Toronto	M	$2,000.00	2	G8H

Record: 1 of 6

TableA

LastName	Sex
Simpson	M
Simpson	F

LastName	Sex
Simpson	M
Smithers	M
Beuieau	F
Burns	M
Simpson	F
Simpson	M

SSN	LastName	MiddleInitial	FirstName	B	ex	Salary	SuperSSN	DeptNum
1	Simpson	P	Bart	2	M	1000	2	G8H
6	Simpson	J	Lisa	6		1000	2	S7G

NEVER SHOW DUPLICATE ROWS IN RELATIONAL ALGEBRA

QUESTION: What would be returned with the expression: $\pi_{\text{MiddleInitial}}(\text{Employee})$

Project : Table

ProjectName	ProjectNumber	ProjectLocation	DeptNumb
Accounting Upd	A1	Toronto	S7G
Acc3	A3	Springfield	G8H
Acct6	A6	Toronto	S7G
Inventory	I1	Toronto	G8H
Inventory2	I2	London	S7G
Payroll	P1	Springfield	G8H
Payroll2	P2	London	G8H
Payroll3	P3	London	G8H

Works_On : Table

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3	A6	45
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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

Department : Table

DeptNumbe	DeptName	ManagerSSN	ManagerStartDate
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Employee : Table

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2	Smithers	J	Waylan	1/1/60	Springfie	M	$2,000.00	4	S7G
3	Beuvieau	P	Patty	3/3/59	Toronto	F	$4,000.00	6	Y5J
4	Burns	P	Montgomer	7/7/20	Toronto	M	$5,000.00		S7G
6	Simpson	J	Lisa	6/6/90	London	F	$1,000.00	2	S7G
12	Simpson	J	Homer	8/8/61	Toronto	M	$2,000.00	2	G8H

Record: 1 of 6

No two rows can ever be the same

MiddleInitial
J
P
J

remove duplicate rows

MiddleInitial
P
J