Lecture S
Relational A

Relational AI

- ***Operators*** are applied ***Operands***
  - ***Operands*** are **relations**
  - ***Operators*** produce resu **relations**

Relational AI

State	Area	Population
AL	52,419	4,661,900
CA	163,696	36,756,666
GA	59,425	9,685,744
NC	53,819	9,222,414
TX	268,820	24,326,974

Relational Al

- Five basic relational alge
  - Selection σ
  - Projection *Π*
  - Union **U**
  - Difference **-**

Selection Ope

- $\sigma_{condition}(R)$
  - Selects tuples from relatio specified criteria
  - A ***condition*** may include

Selection Ope

citypop

City	
Birmingham	
Huntsville	
Atlanta	
Charlotte	
Greensboro	
Huntsville	

Projection Op

- $\Pi_{attribute1,...,attributek}(R)$
  - Deletes attributes not spe
  - **Must also remove dupli maintain the *set propert***

Projection Op

citypop

City	
Birmingham	
Huntsville	
Atlanta	
Charlotte	
Greensboro	
Huntsville	

Rename Ope

- $\rho_{A}(B)$
  - Renames relation B to A w relation

Rename Ope

$$\rho_{TotalResidents \leftarrow Population}(city$$

City	Stat

Set Operat

- ***Union, Intersection, an***
  - Traditional set operations for relations defined for th types

Set Operat

govtemployees

UID	L
4232	
12408	
31023	W
007	
8938	

UID	L

Union Oper

- ***R(X)*** **U** ***S(X)***
  - Results in a relation that c attributes X from either R

Union Oper

presidents U postalworkers =

UID	Last Name
4232	Roosevelt
12408	Franklin

Intersection Op

- ***R(X)*** ∩ ***S(X)***
  - Results in a relation that c attributes X from relations common to both R and S.

Intersection Op

presidents ∩ postalworkers = N

govtemployees ∩ postalworker

Difference Op

- ***R(X) - S(X)***
  - Results in a relation that c attributes X that belong to also belong to relation S.

Difference Op

govtemployees - presidents =

UID	
12408	

govtemployees - postalworker

UID	L

Cartesian Pr

- ***R X S***
  - Given arity k_1 tuple of rela

    tuple of relation S, the Ca
    pairing of all possible tupl
    tuples of S

Cartesian Pr

R

A	B
a	4
b	1
c	5

S

D	E
0	false
1	true

Joins

- Combination of a ***Cartes*** ***Selection*** operation
- Several variations
  - **Theta Join**

Theta Jo

- $R \bowtie_{condition} S$
  - Given arity k_1 tuple of rela

    tuple of relation S, the Ca
    pairing of all possible tupl
    l f S h h h

Theta Jo

R

A	B
1	4
3	1
2	5

S

D	E
2	4

Theta Jo

$$R \bowtie_{C<D} S = \sigma_{C<D}(R \times S)$$

R X S =

A	B	C
1	4	2
1	4	2
3	1	3
3	1	3

Equi-Joi

- $R \bowtie_{equalitycondition} S$
  - Given arity k_1 tuple of rela
    tuple of relation S, the Ca
    pairing of all possible tupl

Natural Jo

- $R \bowtie S$
  - Compute **R X S**
  - For each attribute $\mathbf{A_i}$ com
    select all tuples that agree

Natural Jo

R

A	B
1	4
3	1
2	5

S

A	C
3	3

Natural Jo

(Step #1) Compute R X S

R.A	R.B	R.C	S.A
1	4	2	3
1	4	2	5
1	4	2	2
1	4	2	1
3	1	3	3

Natural Jo

(Step #2) Keep all tuples such th
R.A = S.A AND R.C

R.A	R.B	R.C	S.A
1	4	2	1
3	1	3	3
2	5	6	2

Division

- ***R / S*** "Such That"
  - **R / S = { x | ∀ y ∈ S : ∃<**

"For Each" "Ther

Division

R

A	B
Homer	pants
Homer	shirt
Marge	pants
Marge	shirt
Marge	shoes
Lisa	shirt
Li	h

Laws and The

From these five basic operations
one can derive the following oper

The operations { X, ∪, ⋈, ∩ } are
associative.

Laws and The

$$\sigma_{x \text{ AND } y}(R) = \sigma_x(\sigma_y(R))$$

$$\sigma_x(\sigma_y(R)) = \sigma_y(\sigma_x(R))$$

Tuple Relationa

Relational algebra is a ***procedu***

TRC is a ***nonprocedural query l***

A query as expressed in Tuple Re