

# CSE 4125: Distributed Database Systems

## Chapter – 2: Part A

Review of Databases and Computer  
Networks

# **Review of Databases**

# The Relational Model

- ✓ **Relations**: Data stored in tables.
- ✓ **Attributes**: Fixed number of columns.
- ✓ **Tuples**: Dynamic number of rows.
- ✓ **Grade**: Number of attributes. Column
- ✓ **Cardinality**: Number of tuples. Row

<i>EMPNUM</i>	<i>NAME</i>	<i>AGE</i>	<i>DEPTNUM</i>
3	Jones	27	1
7	Smith	34	2
11	Bob	18	1
15	Jane	23	3
18	Mary	31	1

Grade: 4  
Cardinality: 5

# Relational Schema

- ❑ Representation of a relation.
- ❑ Name of the relation and the attributes appearing in it.

Example:

*EMP (EMPNUM, NAME, AGE, DEPTNUM)*

Grade: 4

# KEYS

Subset of the attributes whose values are unique.

Example:

*EMP* (*EMPNUM*, *NAME*, *AGE*, *DEPTNUM*)

Primary key can be multiple column

# Relational Algebra

- A collection of operations.
- Takes relation(s) as input.
- Produces one relation as result.
- Two types –
  - Unary: 1 input, 1 result*
  - Binary: 2 inputs, 1 result*

# Unary: Selection

Example:  $SL_{A=a} R$

R		
A	B	C
a	1	a
b	1	b
a	1	d
b	2	f

S		
A	B	C
a	1	a
a	3	f

T		
B	C	D
1	a	1
3	b	1
3	c	2
1	d	4
2	a	3

Result		
A	B	C



# Unary: Selection

Example:  $SL_{A=a} R$

R		
A	B	C
a	1	a
b	1	b
a	1	d
b	2	f

S		
A	B	C
a	1	a
a	3	f

T		
B	C	D
1	a	1
3	b	1
3	c	2
1	d	4
2	a	3

Result		
A	B	C
a	1	a
a	1	d

# Unary: Projection

Example:  $PJ_{A,B} R$

R		
A	B	C
a	1	a
b	1	b
a	1	d
b	2	f

S		
A	B	C
a	1	a
a	3	f

T		
B	C	D
1	a	1
3	b	1
3	c	2
1	d	4
2	a	3

Result	
A	B

# Unary: Projection

Example:  $PJ_{A,B} R$

R		
A	B	C
a	1	a
b	1	b
a	1	d
b	2	f

S		
A	B	C
a	1	a
a	3	f

T		
B	C	D
1	a	1
3	b	1
3	c	2
1	d	4
2	a	3

Result	
A	B
a	1
b	1
b	2

# Binary: Union

Example:  $R \cup S$

R		
A	B	C
a	1	a
b	1	b
a	1	d
b	2	f

S		
A	B	C
a	1	a
a	3	f

T		
B	C	D
1	a	1
3	b	1
3	c	2
1	d	4
2	a	3

Result		
A	B	C

# Binary: Union

Example:  $R \cup S$

Need common column

R		
A	B	C
a	1	a
b	1	b
a	1	d
b	2	f

S		
A	B	C
a	1	a
a	3	f

T		
B	C	D
1	a	1
3	b	1
3	c	2
1	d	4
2	a	3

Result		
A	B	C
a	1	a
b	1	b
a	1	d
b	2	f
a	3	f

# Binary: Difference

Example: *R* **DF** *S*

R		
A	B	C
a	1	a
b	1	b
a	1	d
b	2	f

S		
A	B	C
a	1	a
a	3	f

T		
B	C	D
1	a	1
3	b	1
3	c	2
1	d	4
2	a	3

Result		
A	B	C

# Binary: Difference

Example: *R* ***DF*** *S*

R		
A	B	C
a	1	a
b	1	b
a	1	d
b	2	f

S		
A	B	C
a	1	a
a	3	f

T		
B	C	D
1	a	1
3	b	1
3	c	2
1	d	4
2	a	3

Result		
A	B	C
b	1	b
a	1	d
b	2	f

# Binary: Cartesian Product

Example:  $R \bowtie C P S$

R		
A	B	C
a	1	a
b	1	b
a	1	d
b	2	f

S		
A	B	C
a	1	a
a	3	f

T		
B	C	D
1	a	1
3	b	1
3	c	2
1	d	4
2	a	3

Result					
R.A	R.B	R.C	S.A	S.B	S.C



# Binary: Cartesian Product

Example:  $R \bowtie C P S$

R		
A	B	C
a	1	a
b	1	b
a	1	d
b	2	f

S		
A	B	C
a	1	a
a	3	f

T		
B	C	D
1	a	1
3	b	1
3	c	2
1	d	4
2	a	3

Result					
R.A	R.B	R.C	S.A	S.B	S.C
a	1	a	a	1	a
b	1	b	a	1	a
a	1	d	a	1	a
b	2	f	a	1	a
a	1	a	a	3	f
b	1	b	a	3	f
a	1	d	a	3	f
b	2	f	a	3	f

# Binary: Join

Example:  $R \bowtie_{R.C=T.C} T$

R		
A	B	C
a	1	a
b	1	b
a	1	d
b	2	f

S		
A	B	C
a	1	a
a	3	f

T		
B	C	D
1	a	1
3	b	1
3	c	2
1	d	4
2	a	3

Result					
A	R.B	R.C	T.B	T.C	D

# Binary: Join

Example:  $R \bowtie_{R.C=T.C} T$

R		
A	B	C
a	1	a
b	1	b
a	1	d
b	2	f

S		
A	B	C
a	1	a
a	3	f

T		
B	C	D
1	a	1
3	b	1
3	c	2
1	d	4
2	a	3

Result					
A	R.B	R.C	T.B	T.C	D
a	1	a	1	a	1
a	1	a	2	a	3
b	1	b	3	b	1
a	1	d	1	d	4

# Binary: Semi-join

Example:  $R \text{ SJ}_{R.C=T.C} T$

First, R JN T. Then Project the left column

R		
A	B	C
a	1	a
b	1	b
a	1	d
b	2	f

S		
A	B	C
a	1	a
a	3	f

T		
B	C	D
1	a	1
3	b	1
3	c	2
1	d	4
2	a	3

Result		
A	B	C

# Binary: Semi-join

Example:  $R \text{ SJ}_{R.C=T.C} T$

R		
A	B	C
a	1	a
b	1	b
a	1	d
b	2	f

S		
A	B	C
a	1	a
a	3	f

T		
B	C	D
1	a	1
3	b	1
3	c	2
1	d	4
2	a	3

Result		
A	B	C
a	1	a
b	1	b
a	1	d

# Binary: Natural Join

Example:  $R \bowtie T$

Common column er upor base kore join hobe

R		
A	B	C
a	1	a
b	1	b
a	1	d
b	2	f

S		
A	B	C
a	1	a
a	3	f

T		
B	C	D
1	a	1
3	b	1
3	c	2
1	d	4
2	a	3

Result			
A	B	C	D

# Binary: Natural Join

Example:  $R \bowtie T$

R		
A	B	C
a	1	a
b	1	b
a	1	d
b	2	f

S		
A	B	C
a	1	a
a	3	f

T		
B	C	D
1	a	1
3	b	1
3	c	2
1	d	4
2	a	3

Result			
A	B	C	D
a	1	a	1
a	1	d	4

# Binary: Natural Semi-join

Example:  $R \bowtie_{NSJ} T$

First,  $R \bowtie_{NJN} T$ . Then Project the left column

R		
A	B	C
a	1	a
b	1	b
a	1	d
b	2	f

S		
A	B	C
a	1	a
a	3	f

T		
B	C	D
1	a	1
3	b	1
3	c	2
1	d	4
2	a	3

Result		
A	B	C



# Binary: Natural Semi-join

Example:  $R \bowtie_{NSJ} T$

R		
A	B	C
a	1	a
b	1	b
a	1	d
b	2	f

S		
A	B	C
a	1	a
a	3	f

T		
B	C	D
1	a	1
3	b	1
3	c	2
1	d	4
2	a	3

Result		
A	B	C
a	1	a
a	1	d

# Application, Program and Query

## ❑ Database Applications:

- Sequence of operations requested by end users (not a programmer).
- Examples: read.

## ❑ Database Programs:

- Implementation of the application.

## ❑ Query:

- An expression in a suitable language.
- Defines a portion of data contained in DB.