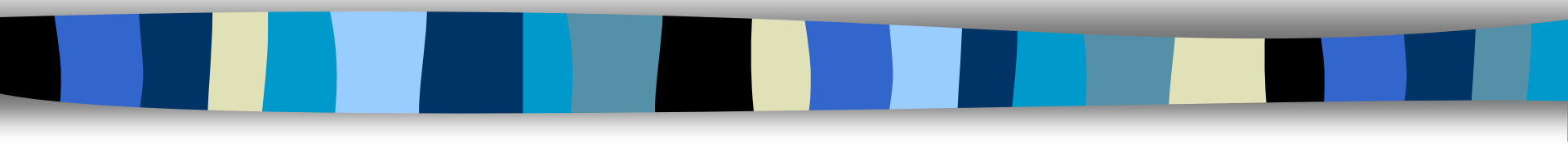
Lecture 5



Introduction to Relational Algebra - 2

Some more about Traditional Set Operators

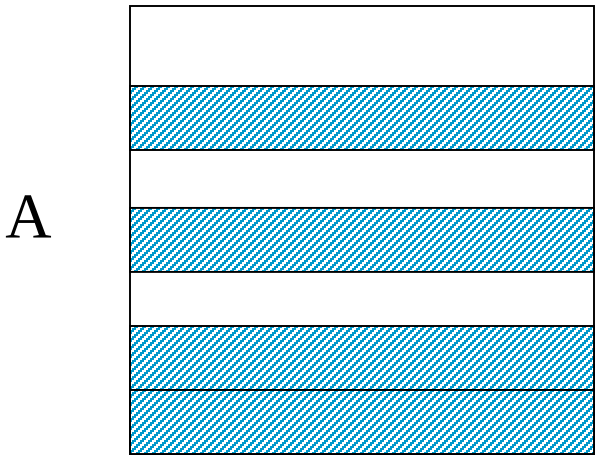
- Commutative
  - **Union**, **Intersect** and **Times** are Commutative:
    - **A UNION B** is equal to **B UNION A**
    - **A INTERSECT B** is equal to **B INTERSECT A**
    - **A TIMES B** is equal to **B TIMES A**
  - **MINUS** is not Commutative i.e.,
    - **A MINUS B** is not equal to **B MINUS A**
- Associative
  - **Union**, **Intersect** and **Times** are Associative:
    - **(A UNION B) UNION C** is equal to **A UNION (B UNION C)**
    - **(A INTERSECT B) INTERSECT C** is equal to **A INTERSECT (B INERSECT C)**
    - **(A TIMES B) TIMES C** is equal to **A TIMES (B TIMES C)**
  - **MINUS** is not Associative i.e.,
    - **(A MINUS B) MINUS C** is not equal to **A MINUS (B MINUS C)**

Special Relational Set Operators

- RESTRICTION
  - is actually abbreviation for ***θ*-restriction**, where "***θ***" stands for any simple scalar comparison operator(=,<,>,=)
  - ***θ*-restriction** of relation **A** on attributes **X** and **Y**(in that order)

    A where X *θ* Y

    is a relation with the same heading as **A** and with a body consisting of the set of all tuples of **A** such that the condition "**X *θ* Y**" evaluates true for those tuples.
  - **X** and **Y** must be defined on the same domain
  - operator must make sense for that domain



Special Relational Operators

- RESTRICTION
  - Returns a relation consisting of all tuples from a specified relation that satisfy a specified condition.

A

ID	Name	Age	Department	NIC
S1	Ahmad	23	Sales	245-77-245367
S2	Salman	34	Marketing	234-66-245368
S3	Karim	21	Sales	255-79-256369
S4	Tariq	29	Admin	245-71-325370
S5	Sadiq	32	Sales	245-68-345371

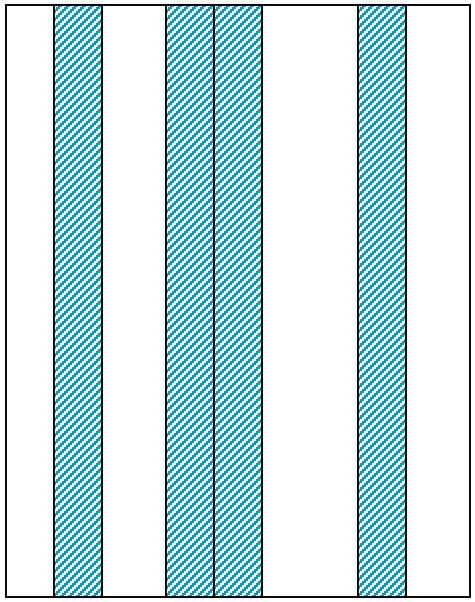
A WHERE Department="Sales"

ID	Name	Age	Department	NIC
S1	Ahmad	23	Sales	245-77-245367
S3	Karim	21	Sales	255-79-256369
S5	Sadiq	32	Sales	245-68-345371

Special Relational Operators

- PROJECTION
  - the projection of relation A on X,Y,….,Z (where each of X,Y,….,Z is an attribute of A) is a relation with heading {X,Y,…,Z } and body consisting of the set of all tuples {X:x,Y:y,…,Z:z } such that a tuple appears in A with X-value x, Y-value y,…., Z-value z.
  - projection yields a vertical subset of relation

A



Special Relational Operators

- PROJECTION
  - Returns a relation consisting of all tuples that remain as (sub) tuples in a specified relation after specified attributes have been eliminated

A

ID	Name	Age	Department	NIC
S1	Ahmad	23	Sales	245-77-245367
S2	Salman	34	Marketing	234-66-245368
S3	Karim	21	Sales	255-79-256369
S4	Tariq	29	Admin	245-71-325370
S5	Sadiq	32	Sales	245-68-345371

A [Name]

Name
Ahmad
Salman
Karim
Tariq
Sadiq

A where Department="Sales" [Name,Department]

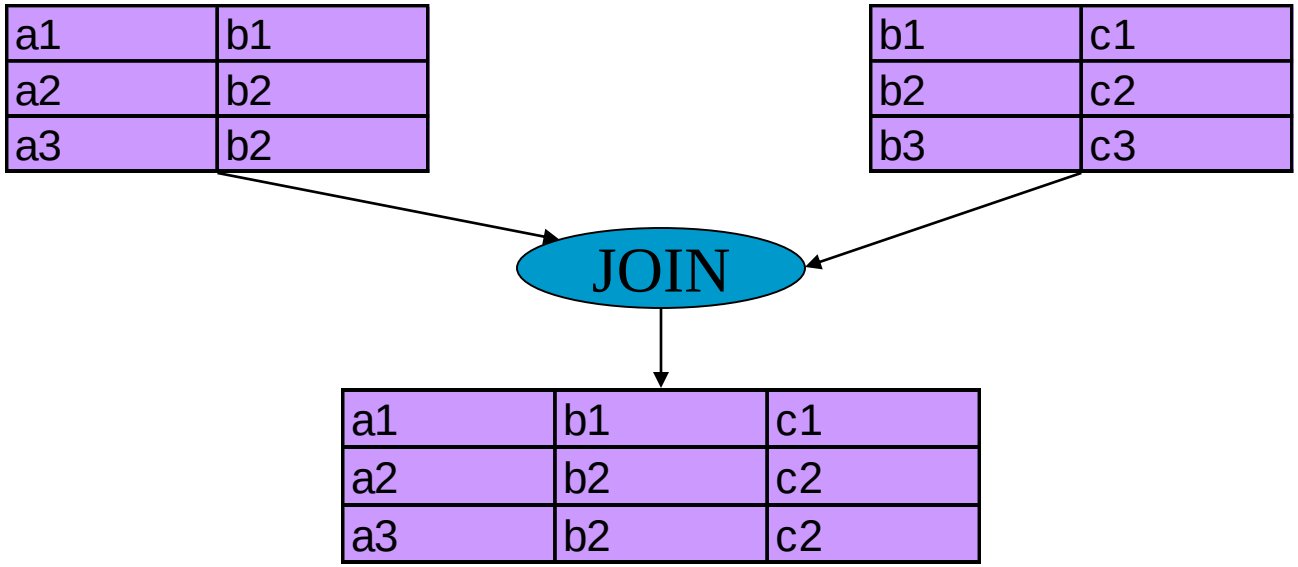
Name	Age	Department
Ahmad	23	Sales
Karim	21	Sales
Sadiq	32	Sales

Special Relational Operators

- JOIN(NATURAL JOIN)
  - Let relations A and B have headings [X,…,Y] and [X,…,Z] respectively, then

    A JOIN B

    is a relation with heading [X,…,Y,…,Z] and with a body consisting of the set of all tuples [X:x,Y:y,Z:z] such that a tuple appears in A with X-value x and Y-value y and in B with X-value x and Z-value z.
  - there should be some common attribute(s)



Special Relational Operators

- JOIN(NATURAL JOIN)
  - Returns a relation consisting of all possible tuples that are combination of two tuples, one from each of the two specified relations, such that two tuples contributing to any given combination have a common value for the common attributes (and that value appears just once)

A

ID	Name
S1	Ahmad
S2	Salman
S3	Karim

B

ID	Subject
S1	Math
S2	Urdu
S1	English

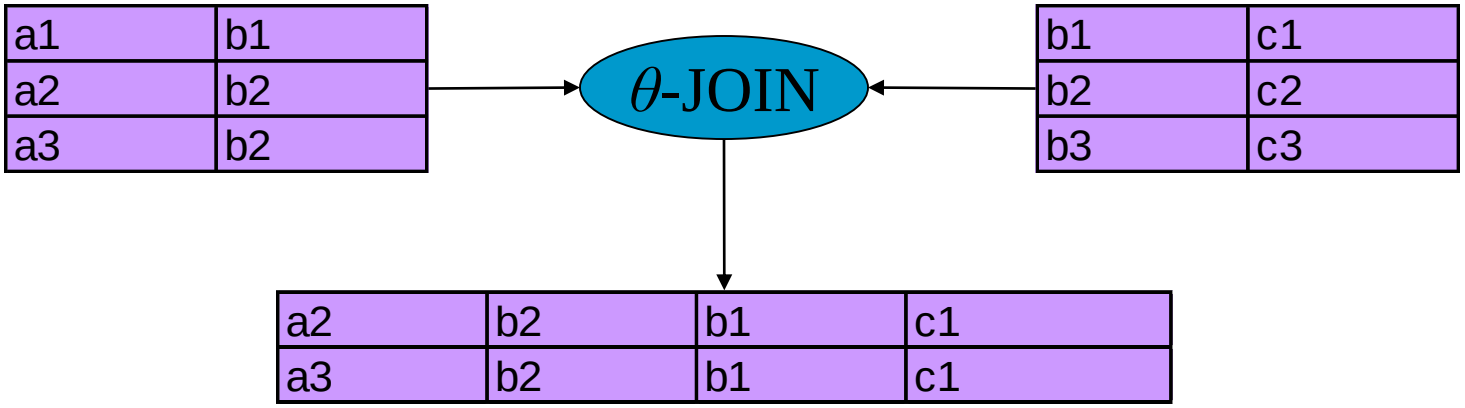
A JOIN B

ID	Name	Subject
S1	Ahmad	Math
S1	Ahmad	English
S2	Salman	Urdu

Special Relational Operators

- *θ*-JOIN
  - Let relations A and B have no attribute names in common (as in Cartesian Product), and let ***θ*** be as defined in restriction. Then the ***θ*-** JOIN of relation A on attribute X with relation B on attribute Y is defined by the result of the expression

    (A TIMES B) where X *θ* Y
  - it is a relation with same heading as Cartesian Product of A and B and with a body consisting of the set of all those tuples belonging to that Cartesian Product of that evaluate true for **X *θ* Y**.
  - if ***θ*** is “equals”, the ***θ*-**JOIN is called an EQUIJOIN.



Special Relational Operators

- θ- JOIN

A

ID	Name
S1	Ahmad
S2	Salman
S3	Karim

B

ID	Subject
S1	Math
S2	Urdu
S1	English

(A TIMES B) where IDA > IDB

IDA	Name	IDB	Subject
S2	Salman	S1	Math
S2	Salman	S1	English
S3	Karim	S1	Math
S3	Karim	S1	English
S3	Karim	S2	Urdu

(A TIMES B) where IDA = IDB

IDA	Name	IDB	Subject
S1	Ahmad	S1	Math
S1	Ahmad	S1	English
S2	Salman	S2	Urdu

Special Relational Operators

- DIVISION
  - Let relations A and B have headings

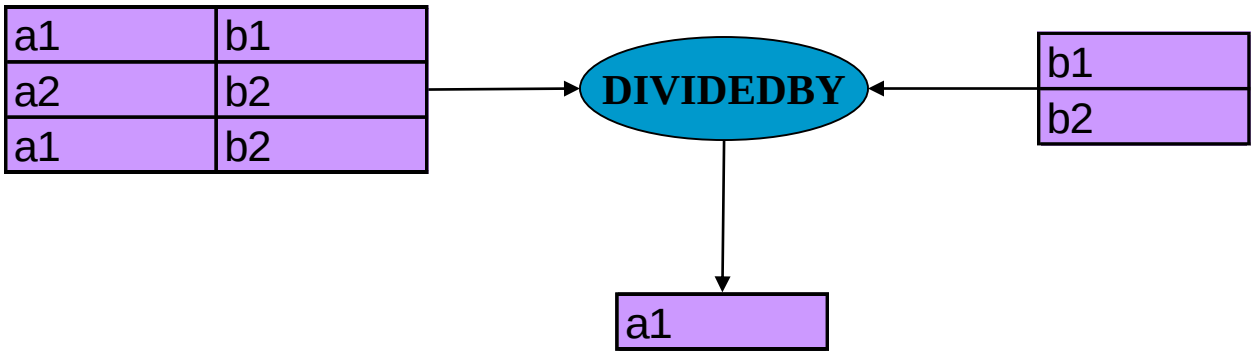
    $\{ x_1, x_2, \ldots, x_m, y_1, y_2, \ldots, y_n\}$ and

    $\{y_1, y_2, \ldots, y_n\}$

    respectively; i.e., attributes $y_1, y_2, \ldots, y_n$ are common, A additionally has attributes $x_1, x_2, \ldots, x_m$, B has no other attributes. Then division of A by B

    A DIVIDEDBY B

    is a relation with heading $x_1, x_2, \ldots, x_m$ and body consisting of the set of all tuples $\{X_1{:}x_1, X_2{:}x_2, \ldots, X_m{:}x_m\}$ such that a tuple $\{X_1{:}x_1, X_2{:}x_2, \ldots, X_m{:}x_m, Y_1{:}y_1, Y_2{:}y_2, \ldots, Y_n{:}y_n\}$ appears in A for all tuples $\{Y_1{:}y_1, Y_2{:}y_2, \ldots, Y_n{:}y_n\}$ appearing in B.
  - A is called dividend(DEND) and B is called divisor(DOR)



Special Relational Operators

- DIVISION
  - Take two relations, one binary and one unary, and returns a relation consisting of all values of one attribute of binary relation that match(in the other attribute) all the values in the unary relation.

A

ID	Subject
S1	Math
S2	Urdu
S1	English
S1	Urdu

B

ID
S1
S2

A DIVIDEBY B

Subject
Urdu

Special Relational Operators

- Some Facts
  - If A and B have no common attribute names in common, A JOIN B is equal to A TIMES B
  - In EQUIJOIN, if one of the two attributes having common values is eliminated (may be through projection), then the result is equal to the natural join.
  - JOIN is both commutative and associative i.e.,

    A JOIN B = B JOIN A

    A JOIN (B JOIN C) = (A JOIN B) JOIN C

Quiz # 2

- Consider relations A and B such that
  - Cardinalty of A= 12, Degree of A= 4
  - Cardinalty of B= 10, Degree of B= 4
  - Cardinalty of A UNION B = 20

what would be the value of following:

- Cardinalty and Degree of A INTERSECT B
- Cardinalty and Degree of A TIMES B
- Degree of A UNION B
- Cardinalty and Degree of A MINUS B
- Cardinalty and Degree of B MINUS A