THE RELATIONAL MODEL

A RELATIONAL DATABASE IS A COLLECTION OF TABLES

TABLES (RELATIONS) CONTAIN

- **ROWS (TUPLES)**
- **ROWS CONTAIN**
  - **COLUMNS (ATTRIBUTES)**
  - **COLUMNS HAVE**
    - **DATA TYPES (DOMAINS)**
    - **VALUES**

THERE IS NO INHERENT ORDERING OF ROWS OR ATTRIBUTES (IN THEORY).

EACH ATTRIBUTE HAS A CONCEPTUAL DOMAIN.

CARDINALITY - TUPLE COUNT (VARIES OVER TIME)

DEGREE (ARITY) - ATTRIBUTE COUNT (FIXED)

THE RELATION IS THE <u>ONLY</u> STRUCTURE IN THE DATABASE

INTEGRITY CONSTRAINTS

KEY

MUST BE UNIQUE

MUST BE MINIMAL

CANDIDATE KEYS

- PRIMARY
- ALTERNATE

FOREIGN KEYS

ATTRIBUTES IN A RELATION THAT MATCH THE PRIMARY KEY OF ANOTHER RELATION (DEFINES A RELATIONSHIP)

ENTITY

NO PRIMARY KEY VALUE CAN BE NULL

REFERENTIAL

EVERY FOREIGN KEY MUST MATCH A CORRESPONDING PRIMARY KEY IN ANOTHER RELATION

RELATIONAL ALGEBRA

THE DERIVATION OF NEW RELATIONS BY THE APPLICATION OF RELATIONAL OPERATORS TO EXISTING RELATIONS (EITHER BASE OR DERIVED)

CLOSURE - THE RESULT OF ALL RELATIONAL ALGEBRA OPERATIONS IS A RELATION

THIS ALLOWS FOR NESTED EXPRESSIONS

GIVEN: 2 RELATIONS R AND S

WHERE R IS OF DEGREE r

R (A_1, A_2, A_3, ..., A_r)

AND S IS OF DEGREE s

S (A_1, A_2, A_3, ..., A_S)

EXAMPLES:

<u>RELATION R</u>

A	B	C
a	b	c
d	a	f
c	b	d

<u>RELATION S</u>

D	E	F
b	g	a
d	a	f

THE FOLLOWING EXAMPLES ARE BASED ON THIS R AND S.

<u>UNION</u> **R U S**

THE SET OF TUPLES IN R OR S OR BOTH.

THE TWO RELATIONS MUST HAVE THE SAME DEGREE AND CORRESPONDING ATTRIBUTES SHOULD BE BASED ON THE SAME DOMAIN. (UNION COMPATIBLE)

EXAMPLE :- R U S

a	b	c
d	a	f
c	b	d
b	g	a

<u>DIFFERENCE</u> **R - S (R & S MUST BE UNION COMPATIBLE)**

THE SET OF TUPLES IN R BUT NOT IN S

EXAMPLE :- R - S

a	b	c
c	b	d

CARTESIAN PRODUCT R X S

THE SET OF (r + s) TUPLES WHOSE FIRST r COMPONENTS REPRESENT A TUPLE FROM R AND WHOSE LAST s COMPONENTS REPRESENT A TUPLE FROM S.

EXAMPLE :- R X S

A	B	C	D	E	F
a	b	c	b	g	a
a	b	c	d	a	f
d	a	f	b	g	a
d	a	f	d	a	f
c	b	d	b	g	a
c	b	d	d	a	f

INTERSECTION R ∩ S

THE SET OF TUPLES IN BOTH R AND S.

EXAMPLE :- R ∩ S

d	a	f

ALSO R ∩ S ≡ R - (R - S)

SELECTION σ_F (R)

THE SET OF TUPLES IN R FOR WHICH F IS TRUE

F IS A FORMULA COMPOSED OF :

1) CONSTANTS AND ATTRIBUTES
2) COMPARISON OPERATORS [=, >, <, ≤, ≥, ≠]
3) LOGICAL OPERATORS [AND, OR, NOT]

EXAMPLE :

$\sigma_{A > B}$ (R)

d	a	f
c	b	d

$\sigma_{B = 'b'}$ (R)

a	b	c
c	b	d

PROJECTION $\pi\ i_1, i_2, i_3, \ldots, i_m$ (R)

IT IS THE SET OF ALL TUPLES IN R WITH ATTRIBUTES REMOVED AND / OR REARRANGED.

$i_1, i_2, i_3, \ldots, i_m$ REPRESENTS A SUBSET OF ALL THE ATTRIBUTES OF R

[DUPLICATES ARE ELIMINATED SO CARDINALITY CAN DECREASE]

EXAMPLES : $\pi_{A, C}$ (R)

a	c
d	f
c	d

$\pi_{E, D}$ (S)

g	b
a	d

JOIN

θ - JOIN $R \underset{i\,\theta\,j}{|X|} S$

THE SET OF TUPLES IN THE CARTESIAN PRODUCT (R X S) WHERE i θ j IS TRUE

i IS AN ATTRIBUTE OF R

θ IS A RELATIONAL OPERATOR

j IS AN ATTRIBUTE OF S

IF θ IS " = " THE OPERATION IS CALLED AN EQUIJOIN

EXAMPLE : $R \underset{C > F}{|X|} S$

A	B	C	D	E	F
a	b	c	b	g	a
d	a	f	b	g	a
c	b	d	b	g	a

BTW:

$$R \underset{i\,\theta\,j}{|X|} S \equiv \sigma_{i\,\theta\,j}\,(R \times S)$$

NATURAL JOIN R |X| S

THE SET OF TUPLES IN THE CARTESIAN PRODUCT (R X S) WHERE MATCHING ATTRIBUTES IN R AND S HAVE THE SAME VALUES.
REDUNDANT ATTRIBUTES OF S ARE PROJECTED OUT.

EXAMPLE :

R

A	B	C
a	b	c
d	b	c
b	b	f
c	a	d

S

B	C	D
b	c	d
b	c	e
a	d	b

R |X| S

A	B	C	D
a	b	c	d
a	b	c	e
d	b	c	d
d	b	c	e
c	a	d	b

$\pi_{list} \quad \sigma_{F} \quad (R \times S)$

LIST = ATTRIBUTES OF (R X S) LESS MATCHING ATTRIBUTES OF S.

F = MATCHING ATTRIBUTES HAVE THE SAME VALUES.

<u>DIVISION</u> (QUOTIENT)

R ÷ S REQUIRES r > s

IS THE SET OF (r - s) TUPLES T SUCH THAT FOR ALL s TUPLES U IN S, THE TUPLE TU IS IN R.

EXAMPLE : R ÷ S

*** R AND S ARE CHANGED HERE TO ILLUSTRATE DIVISION.**

R

A	B	C	D
a	b	c	d
a	b	e	f
b	c	e	f
e	d	c	d
e	d	e	f
a	b	d	e

S

C	D
c	d
e	f

QUOTIENT

A	B
a	b
e	d

$$R \div S \equiv \pi_{r-s}(R) - \pi_{r-s}((\pi_{r-s}(R) \times S) - R)$$

$\pi_{r-s}(R)$

=

a	b
b	c
e	d

X S =

a	b	c	d
a	b	e	f
b	c	c	d
b	c	e	f
e	d	c	d
e	d	e	f

- R =

b	c	c	d

$\pi_{r-s}((\pi_{r-s}(R) X S) - R)$ =

b	c

$\pi_{r-s}(R) - \pi_{r-s}(\quad)$ = **QUOTIENT**

a	b
b	c
e	d

-

b	c

=

a	b
e	d