Foundation University
Rawalpindi Campus

Introduction to Database Systems – CSC - 221

A Presentation by

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RECAP

- MY NAME IS...........
- I REMEMBER.........

Objective of Today's Lecture

Relations and Relational Algebra

RDM – Two Major Strengths

- Simplicity – Relation Form
- Strong Mathematical Foundation

Relational Data Model

- Presented by E. F. Codd in 1970
- Before Relational Data Model, two older data models were in use;
- Hierarchical
- Network

Basics of RDM

- Mainly used for external, conceptual, and to some extent physical schema.
- Separation of conceptual and physical levels makes manipulation much easier, contrary to previous data models.

Basics of RDM

- The basic structure is relation.
- Relations physically represented as tables.
- Consists of rows and columns
- Both entities and relationships are modeled using tables/relations.

Basics of RDM

- Columns represent attributes and rows represent records.
- Rows, records and tuples all these terms are used interchangeably.

A Table/Relation

stID	stName	clName	doB	Gender
S001	Zofeen	BCSE	12/6/92	F
S002	Rohaf	BCSE	3/9/92	M
S003	Noshail	BSCS	7/8/93	F
S004	Rameen	BCA	23/4/94	F
S005	Bilaval	BBA	22/7/93	M

Relation - Terminology

- ***Degree of a relation***: how long the tuples are, or how many columns the table has.
  - In the exemplary relation, degree of the relation is 5

- ***Cardinality of the relation***: how many different tuples are there, or how many different rows the table has.
  - In the exemplary relation, cardinality of the relation is 5

Mathematical Relations

- Consider two sets
  - A = {x, y}
  - B = {2, 4, 6}
- Cartesian product of these sets
  - A X B = {(x,2), (x,4), (x,6), (y,2), (y,4), (y,6)}

Mathematical Relations

- A relation is some subset of this Cartesian product, For example
  - R1= {(x,2), (y,2),(x,6),(x,4)}
  - R2 = {(x,4), (y,6), (y,4)}

Relational Model: Data Manipulation

- Data is represented as relations.
- Manipulation of data (query and update operations) corresponds to operations on relations.
- Relational algebra describes those operations. They take relations as arguments and produce new relations.
- Think of numbers and corresponding operators +,–,\, * or booleans and corresponding operators &,|,! (and, or, not).
- Relational algebra contains two kinds of operators: common set-theoretic ones and operators specific to relations (for example projecting on one of the columns).

Union

- Standard set-theoretic definition of union:
  - $A \cup B = \{x : x \in A \text{ or } x \in B\}$
- For example, $\{a,b,c\} \cup \{a,d,e\} = \{a,b,c,d,e\}$
- So we require in order to take a union of relations R and S that R and S have the same number of columns and that corresponding columns have the same domains.

Union – Compatible Relations

- Two relations R and S are ***union-compatible*** if they have the **same number of columns** and corresponding columns have the **same domains.**

Example: Not Union Compatible

- Not Compatible!
- Different number of columns!

Anne	aaa	111111
Bob	bbb	222222
Chris	ccc	333333

Tom	1980
Sam	1985
Steve	1986

Example: Not Union Compatible

- **Not Compatible!**
- **Different domains for the second column!**

Anne	aaa
Bob	bbb
Chris	ccc

Tom	1980
Sam	1985
Steve	1986

Example: Union-Compatible

Anne	1970
Bob	1971
Chris	1972

Tom	1980
Sam	1985
Steve	1986

Union of Two Relations

- Let R and S be two union-compatible relations. Then their union $R \cup S$ is a relation which contains tuples from both relations:

  $$R \cup S = \{x : x \in R \text{ or } x \in S\}.$$

- Note that union is a partial operation on relations: it is only defined for some (compatible) relations, not for all of them.
- Similar to division for numbers (result of division by 0 is not defined).

Example: Shopping Lists

R

Cheese	1.34
Milk	0.80
Bread	0.60
Eggs	1.20
Soap	1.00

S

Cream	5.00
Soap	1.00

R ∪ S

Cheese	1.34
Milk	0.80
Bread	0.60
Eggs	1.20
Soap	1.00
Cream	5.00

Difference of Two Relations

Let R and S be two union-compatible relations. Then their ***difference*** R – S is a relation which contains tuples which are in R but not in S:

$$R - S = \{x : x \in R \text{ and } x \notin S\}.$$

- Note that difference is also a partial operation on relations.

Example

R

Cheese	1.34
Milk	0.80
Bread	0.60
Eggs	1.20
Soap	1.00

S

Cream	5.00
Soap	1.00

R – S

Cheese	1.34
Milk	0.80
Bread	0.60
Eggs	1.20

Intersection of Two Relations

- Let R and S be two union-compatible relations. Then their *intersection* is a relation $R \cap S$ which contains tuples which are both in R and S:

$$R \cap S = \{x: x \in R \text{ and } x \in S\}$$

- Note that intersection is also a partial operation on relations.

Intersection

R	S	R ∩ S

Cheese	1.34
Milk	0.80
Bread	0.60
Eggs	1.20
Soap	1.00

Cream	5.00
Soap	1.00

Soap	1.00

CHHUTTI

AND THAT IS FAREWELL TO DAY 15 ☺