RELATIONAL MODEL

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Relational Data Model

- Presented by E. F. Codd in 1970, then of IBM
- Based on predicate logic and set theory
- First DBMS built on Relational Data Model (RDM) was system R
- Another Relational DBMS built during those days was INGRES
- The basic structure is relation

Characteristics of a Relational Table

- A table is perceived as a two-dimensional structure composed of rows and columns.
- Each table row (tuple) represents a single entity occurrence within the entity set.
- Each table column represents an attribute, and each column has a distinct name.
- Each row/column intersection represents a single data value.
- All values in a column must conform to the same data format.
- Each column has a specific range of values known as the attribute domain.
- The order of the rows and columns is immaterial to the DBMS.
- Each table must have an attribute or a combination of attributes that uniquely identifies each row.

Table

STID	STNAME	CLNAME	DOB	SEX
S001	M. Suhail	MCS	12/6/84	M
S002	M. Shahid	BCS	3/9/86	M
S003	Naila S.	MCS	7/8/85	F
S004	Rubab A.	MBA	23/4/86	F
S005	Ehsan M.	BBA	22/7/88	M

Keys

- Keys are used to ensure that each row in a table is uniquely identifiable.
- It establish relationships among tables and to ensure the integrity of the data.
- Key consists of one or more attributes that determine other attributes.

Simple or Composite Key

- A key consisting of single attribute is called simple key, e.g., StudentID, ItemNo
- A key consisting of more than one attribute is known as composite key, like {Program_Code,Course_Code}

Composite Key Example

COURSE_OFFERING

ProgCode	**CourseCode**	**Total Marks**	**CrHrs**
MCS	DS	100	3
MCS	DBS	100	3
MBA	DBS	100	3
BCS	NW	100	3

Super Key

A super key is a set of one or more attributes which can uniquely identify a row in a table.

StdId	**StdName**	**Address**	**ClName**	**CurSem**
S1020	Suhail	Gulshan	MCS	4
S1038	Shoaib	Model Town	BCS	3
S1015	Tahira	Gulberg	MCS	2
S1018	Arif	Korangi	BIT	4
S1025	Suhail	FB Area	BCS	6

Candidate Key

Candidate keys are selected from the set of super keys, the only thing we take care while selecting candidate key is: It should not have any redundant attribute. That's the reason they are also termed as minimal super key.

StdId	StdName	Address	ClName	CurSem
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Primary Key

- A primary key is the main/chosen candidate key from the possible set of candidate keys that is most suitable for entity identification.
- It may be a single attribute or a composite key.
- None of its attributes can have NULL values.
- The other candidate keys called Alternate keys provide another method of accessing records.

Note: A null is no value at all. It does not mean a zero or a space.

Foreign Key

An attribute of a table B that is primary key in another table A

Consider the given tables

Enrolled (sid, cid, grade)

Students (sid, name, login, age, gpa)

Enrolled

sid	cid	grade
53666	Carnatic101	C
53666	Reggae203	B
53650	Topology112	A
53666	History105	B

Students

sid	name	login	age	gpa
53666	Jones	jones@cs	18	3.4
53688	Smith	smith@eecs	18	3.2
53650	Smith	smith@math	19	3.8

Secondary Key

A secondary key is defined as a key that is used strictly for data retrieval purposes.

Suppose customer data are stored in a CUSTOMER table in which the customer number is the primary key. Do you suppose that most customers will remember their numbers? Data retrieval for a customer can be facilitated when the customer's last name and phone number are used. In that case, the primary key is the customer number; the secondary key is the combination of the customer's last name and phone number.

Keep in mind that a secondary key does not necessarily yield a unique outcome.

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)}
- 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)}
- The same notion of Cartesian product and relations can be applied to more than two sets

Name = {Ali, Sana, Ahmed, Sara}

Age = {15,16,17,18,……,25}

- Cartesian product of Name & Age
  Name X Age= {(Ali,15), (Sana,15), (Ahmed,15), (Sara,15), …., (Ahmed,25), (Sara,25)}

Database Relations

- Let A1, A2, A3, …, A_n be some attributes and D1, D2, D3,…, D_n be their domains
- A relation scheme relates certain attributes with their domain in context of a relation
- Can be represented as
- R = (A1:D1, A2:D2, ……, An:Dn)
- STD = (stId:Text, stName: text, stAdres:Text, doB:Date) OR
- STD(stId, stName, stAdres, doB)

Integrity Constraints

Two main types

- Entity integrity constraint
  - Primary key cannot have null value
- Referential integrity constraint
  - Value of Foreign key is either null or matches with a value in its home relation

Practice

For each table in the database, identify the primary key and the foreign key(s).

Do the tables exhibit entity and referential integrity?

Table name: EMPLOYEE

EMP_CODE	EMP_LNAME	JOB_CODE
14	Rudell	2
15	McDade	1
16	Ruellardo	1
17	Smith	3
20	Smith	2

Table name: BENEFIT

EMP_CODE	PLAN_CODE
15	2
15	3
16	1
17	1
17	3
17	4
20	3

Table name: JOB

JOB_CODE	JOB_DESCRIPTION
1	Clerical
2	Technical
3	Managerial

Table name: PLAN

PLAN_CODE	PLAN_DESCRIPTION
1	Term life
2	Stock purchase
3	Long-term disability
4	Dental