Relational Model

Introduction

- Relational model introduced by Codd in 1970.

- It uses the concept of mathematical relation – concept of set theory and predicate logic

- It represents the database as a collection of relations.

Relational Model Concepts

- Relation or table
- Attribute or field or column name
- Tuples or record
- Schema
- Instance
- Domains
- Keys
- **Degree:** The total number of attributes which in the relation is called the degree of the relation.
- **Cardinality:** Total number of rows present in the Table.

Student Relation

NAME	ROLL_NO	PHONE_NO	ADDRESS	AGE
Ram	14795	7305758992	Noida	24
Shyam	12839	9026288936	Delhi	35
Laxman	33289	8583287182	Gurugram	20
Mahesh	27857	7086819134	Ghaziabad	27
Ganesh	17282	9028293988	Delhi	40

- NAME, ROLL_NO, PHONE_NO, ADDRESS, and AGE are the attributes.
- The instance of schema STUDENT has 5 tuples.
- t3 = <Laxman, 33289, 8583287182, Gurugram, 20> is the third tuple in the student table
- ROLL_NO is primary key in the table
- Degree = 5 (No of Columns)
- Cardinality = 5 (No of Rows)

Relational Model Concepts Cont.…

Domain

- It contains a set of permitted atomic values for an attribute in the table.

- We specify domain of attribute while creating a table.

- E.g.,
  - Month of an year can accept all the month name or numbering from 01 to 12.
  - Domain of date can accept of possible dates.

Relational Model Concepts Cont.…

Relational Model Concepts Cont.…

Keys

- An attribute or set of attributes which can identify the row (tuple or record) in the relation uniquely.

- It is used to access the stored data quickly and smoothly

- It is used to create relationship between different tables.

Relational Model Concepts Cont.…

Types of Keys:

- Primary Key
- Candidate Key
- Alternate Key
- Super Key
- Composite Key
- Foreign Key
- Unique Key

Relational Model Concepts Cont.…

Primary Key (PK)

Employee
EID
Name
SSN
DeptId
DOB

- It is unique and can not have NULL value

- It is chosen by designer to maintain uniqueness at row level.

- In the Employee table, EID or SSN can be a PK.

- EID is preferable because SSN is PII value and secure.

Relational Model Concepts Cont.…

Candidate Key (CK)

- All the columns that qualifies for uniqueness of each row.

- It is also called as minimal super keys.

- In the Employee table, EID are SSN are CK.

- We pick one of the CKs as PK.

Employee
EID
Name
SSN
DeptId
DOB

Relational Model Concepts Cont.…

Alternate Key

- Candidate column other than primary column is called Alternate key.

- In the Employee table, SSN is alternate key.

Employee
EID
Name
SSN
DeptId
DOB

Relational Model Concepts Cont.…

Super Key

- If we add any other column with candidate key, then it becomes super key.

- One or more attributes are taken collectively to identify all other attributes uniquely.

- In the Employee table, EID+Name, SSN+DeptId are super keys.

Employee
EID
Name
SSN
DeptId
DOB

Relational Model Concepts Cont.…

Composite Key

- If a table does not have CKs, then we select two or more columns to uniquely identify each row in a table.

- In the Employee table, Name+DOB can be used as a composite

  primary key

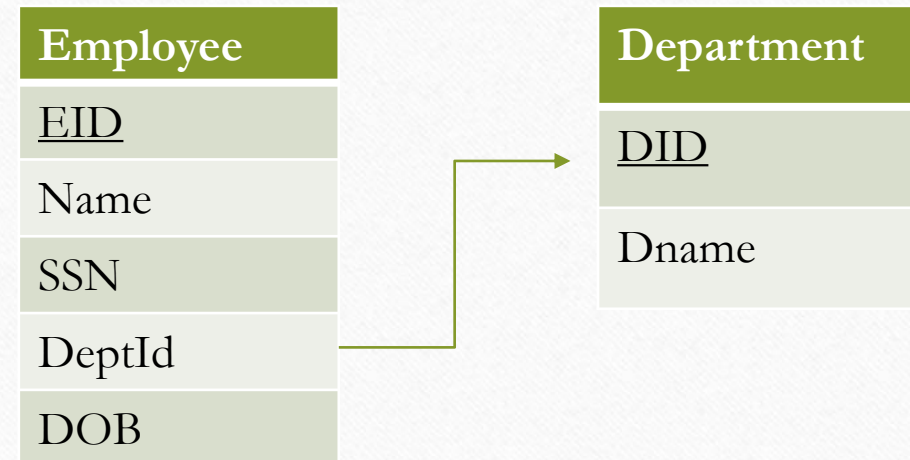| Employee |
|----------|
| EID |
| Name |
| SSN |
| DeptId |
| DOB |

Relational Model Concepts Cont.…

Foreign Key (FK)

- It is an attribute or set of attributes that references to PK of same table or another table.

- DeptId is FK in Employee Table.

Employee
EID
Name
SSN
DeptId
DOB

Department
DID
Dname

Relational Model Concepts Cont.…

Unique Key

- It is same as the PK, but the difference is with the existence of NULL value.

- It allows one value as NULL value.

Employee
EID
Name
SSN
DeptId
DOB

Relational Model Constraints

- Relational constraints are the restrictions imposed on the database contents and operations.

- They ensure the correctness of data in the database.

Constraint Types:

- Domain Constraints

- Key Constraints

- Entity Integrity Constraints

- Referential Integrity Constraints

Relational Model Constraints Cont. …

Domain Constraints:

- Domain constraint defines the domain or set of values for an attribute.

- It specifies that the value taken by the attribute must be the atomic value from its domain.

- In the Student table, value **'A'** is not allowed since only integer values can be taken by the age attribute.

STU_ID	Name	Age
S001	Akshay	20
S002	Abhishek	21
S003	Shashank	20
S004	Rahul	**A**

Relational Model Constraints Cont. …

Key Constraints:

- All the values of primary key must be unique.

- This student relation does not satisfy the key constraint as here all the values of primary key are not unique.

STU_ID	Name	Age
S001	Akshay	20
S001	Abhishek	21
S003	Shashank	20
S004	Rahul	21

Relational Model Constraints Cont. …

Entity Integrity Constraints:

- It specifies that no attribute of primary key must contain a null value in any relation.
- This is because the presence of null value in the primary key violates the uniqueness property.
- This student relation does not satisfy the entity integrity constraint as here the primary key contains a NULL value.

STU_ID	Name	Age
S001	Akshay	20
S002	Abhishek	21
S003	Shashank	20
	Rahul	21

Relational Model Constraints Cont. …

Referential Integrity Constraints:

- This constraint is enforced when an FK references the PK of a relation.

- It specifies that all the values taken by the FK must either be available in the relation of the PK or be null.

- We can not insert a record into a referencing relation if the corresponding record does not exist in the referenced relation.

- We can not delete or update a record of the referenced relation if the corresponding record exists in the referencing relation.
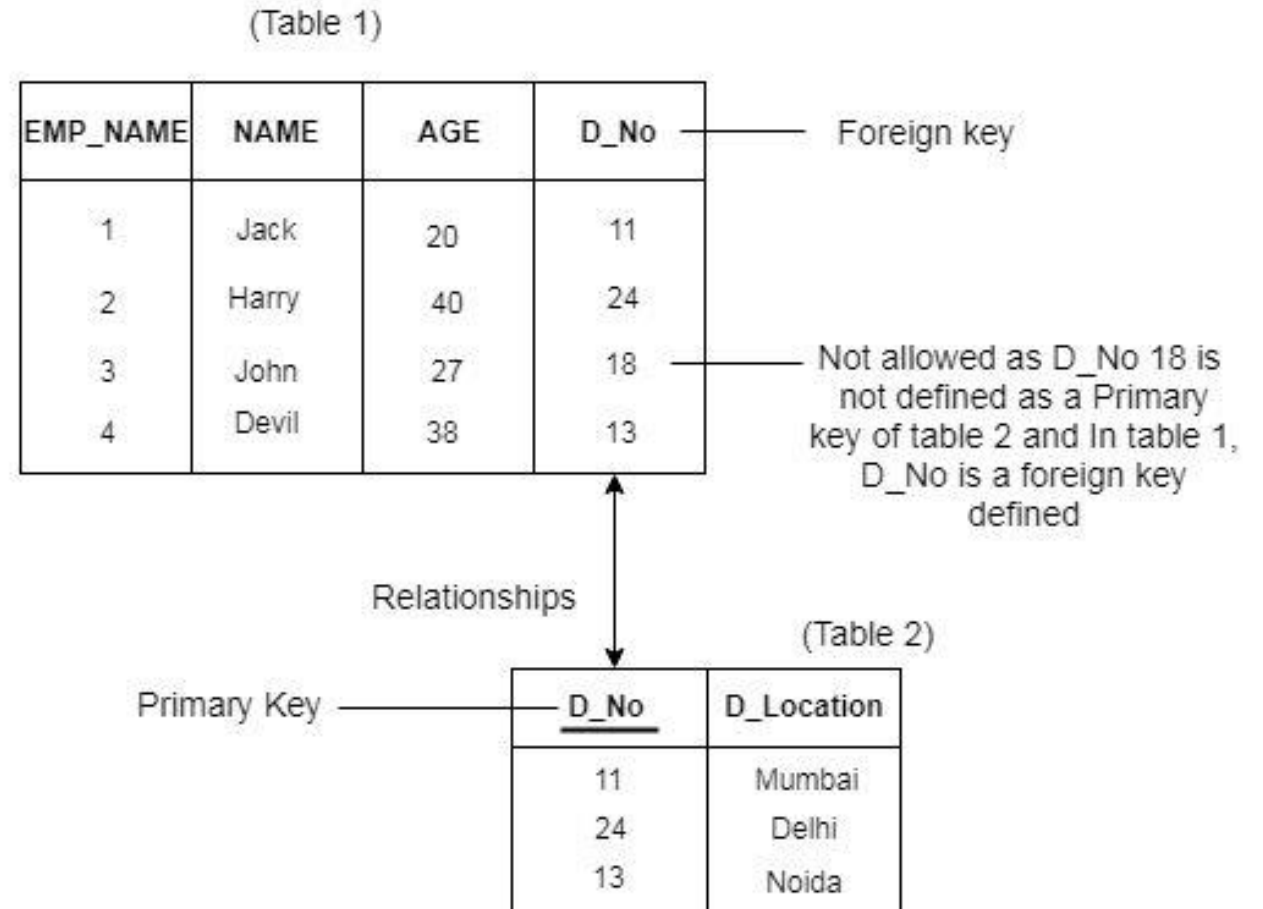
Referential Integrity Constraint Violation

- Cause-01: Insertion in a referencing relation

- Cause-02: Deletion from a referenced relation

- Cause-03: Updating in a referenced relation

Relational Model Constraints Cont.

Referential Integrity Constraints:

- It is specified between two tables.

- If an FK in Table 1 refers to the PK of Table 2, then every value of the FK in Table 1 must be null or be available in Table 2.

(Table 1)

EMP_NAME	NAME	AGE	D_No
1	Jack	20	11
2	Harry	40	24
3	John	27	18
4	Devil	38	13

Foreign key

Not allowed as D_No 18 is not defined as a Primary key of table 2 and In table 1, D_No is a foreign key defined

Relationships

Primary Key

(Table 2)

D_No	D_Location
11	Mumbai
24	Delhi
13	Noida

Guess under which A is not allowed ??

ID	NAME	SEMENSTER	AGE
1000	Tom	1st	17
1001	Johnson	2nd	24
1002	Leonardo	5th	21
1003	Kate	3rd	19
1004	Morgan	8th	A

Not allowed. Because AGE is an integer attribute

Guess under which constraint A is not allowed ??

ID	NAME	SEMENSTER	AGE
1000	Tom	1st	17
1001	Johnson	2nd	24
1002	Leonardo	5th	21
1003	Kate	3rd	19
1004	Morgan	8th	A

Not allowed. Because AGE is an integer attribute

Persons Table

PersonID	LastName	FirstName	Age
1	Hansen	Ola	30
2	Svendson	Tove	23
3	Pettersen	Kari	20

Orders Table

OrderID	OrderNumber	PersonID
1	77895	3
2	44678	3
3	22456	2
4	24562	1

The following table has two attributes A and C where A is the primary key and C is the foreign key referencing A with on-delete cascade.

A	C
2	4
3	4
4	3
5	2
7	2
9	5
6	4

The set of all tuples that must be additionally deleted to preserve referential integrity when the tuple (2,4) is deleted is:
(A) (3,4) and (6,4)
(B) (5,2) and (7,2)
(C) (5,2), (7,2) and (9,5)
(D) (3,4), (4,3) and (6,4)

The following table has two attributes A and C where A is the primary key and C is the foreign key referencing A with on-delete cascade.

A C

-----

2 4

3 4

4 3

5 2

7 2

9 5

6 4

The set of all tuples that must be additionally deleted to preserve referential integrity when the tuple (2,4) is deleted is:
(A) (3,4) and (6,4)
(B) (5,2) and (7,2)
(C) (5,2), (7,2) and (9,5)
(D) (3,4), (4,3) and (6,4)

References

- https://www.javatpoint.com/dbms-integrity-constraints

- https://www.guru99.com/relational-data-model-dbms.html

- https://www.gatevidyalay.com/constraints-in-dbms-types-of-constraints-in-dbms/

- https://beginnersbook.com/2015/04/rdbms-concepts/