

## Tutorial 7 – Relational Model

### WITH SUGGESTED SOLUTIONS

---

#### Review Questions

1. Describe the properties of relations.

**Answer:**

- Order of attributes (columns) has no significance
- Order of tuples (rows) has no significant
- all attribute values are atomic
- there are no duplicate tuples (all rows are unique)

2. Explain the concept of atomicity of values.

**Answer:**

Atomic values cannot be decomposed into *meaningful* sub-values, e.g. POSTCODE.

3. Define integrity rules that apply to the relational model.

**Answer:**

Entity integrity: primary key attributes cannot take null values

Referential Integrity: foreign key values must match primary key values in the referenced relation, or be entirely null.

Domain integrity: attribute values are drawn from corresponding domains

4. Explain the meaning of a domain. Discuss how domains influence relational operations, e.g. joins, unions, etc.

**Answer:**

A domain is a collection of values from which an attribute value is drawn. Only attributes drawn from the same domain can be used as joining attributes. Union operation requires that corresponding attributes have identical domains.

5. Define the following keys: candidate key, primary key, alternate key, super key, foreign key.

- Candidate key: candidate key must be unique (i.e. unique attribute or unique combination of attributes) and minimal (i.e. for composite keys no attribute can be discarded without losing uniqueness)
- Primary key: a candidate key chosen (by the designer) to be primary key
- Alternate key: candidate keys not chosen (by the designer) to be primary key
- Super key: unique combination of attributes that is a superset of a candidate key, i.e. not minimal combination of attributes
- Foreign key: an attribute or combination of attributes in a (referencing) relation that correspond(s) to a primary key of another (referenced) relation.

6. What is a relational DBMS (RDBMS), comment on its underlying data model, and the relationship between logical and physical data structures:
- A relational DBMS (or RDBMS) is a database management system that implements the relational data model.
  - Data are stored in tables, and the data relationships are represented by common values, (i.e. not pointers).
  - In a relational database a table is a logical construct rather than a physical construct, so a table need not correspond to a physical file of records. The same data model may have many different possible physical implementation structures. Designing the physical database is usually the concern of the database administrators.
7. Explain how are relationships implemented in a relational database.

**Answer:**

Relationships are implemented by matching data values stored in primary and foreign key columns. Note that relationships and relations are not the same concepts!! Relations are related via relationships that are represented by foreign keys.

**Problems and Exercises**

1. Consider an employee database consisting of two relations:

**Emp**(Empno, EmpName, Sal, Deptno\*)

**Dept**(Deptno, Deptname, Mrgno\*)

Where the attribute DEPTNO in relation EMP is a foreign key to relation DEPT and attribute MGRNO in relation DEPT is a foreign key to relation EMP.

**DEPT table**

Deptno	DeptName	MgrNo
10	Accounting	125
15	IT	115
20	Sales	110
25	Service	120

**EMP table**

EmpNo	EmpName	Sal	DeptNo
110	Andrew	75000	20
115	Betty	75000	15
120	Charles	75000	25
125	David	75000	10
130	Erick	54000	25
135	Fred	35000	10
140	Garry	63000	10

- a) Assume that department 10 is to be deleted. Discuss the strategies available for maintaining referential integrity in this situation.

**Answer:**

Following strategies are possible:

**Restrict:** delete operation cannot proceed if there are related records in the EMP table (i.e. employees in department 10)

**Cascade:** delete operation is cascaded to related records in the EMP table (i.e. employees in department 10 are also deleted)

**Nullify:** department no 10 is deleted and DEPTNO in related records in the EMP table (i.e. employees in department 10) is set to null

- b) Employee David was fired; comment on the integrity implications of removing David from the database.

**Answer:**

As David is the manager of department 10, deleting David from EMP implies changes to the corresponding row in the DEPT table. Depending on the business rule applied to this situation, the MGRNO in the row representing department 10 will be set to null (i.e. nullify strategy), or set to a value corresponding to another manager employee (i.e. another manager was appointed).

- c) Assuming that the following applies:
- each department must have one manager and each manager can only manage a single department
  - departments have unique names

How many candidate keys does table DEPT have?

**Answer:** 3 – DEPTNO, DEPTNAME, and MGRNO

- d) Can DEPTNAME become the primary key of relation DEPT?

**Answer:** yes, it is a design decision, but usually we choose the most stable candidate key as the primary key i.e. the values do not change regularly or at all.

- e) Discuss the implications of drawing the values of EMPNO and MGRNO from the same domain of employee numbers.

**Answer:**

Allows join and union operations involving EMPNO and MGRNO columns.

2. For the database in question 1 above give corresponding create table statements for tables EMP and DEPT. Use integer and char data types as appropriate. Make sure that you define primary and foreign keys for both tables.

**Answer:**

```
CREATE TABLE EMP
  (EMPNO NUMBER,
   EMPNAME CHAR(40),
   SAL NUMBER,
   DEPTNO NUMBER,
   CONSTRAINT EMPNO_PK PRIMARY KEY (EMPNO),
   CONSTRAINT DEPTNO_FK FOREIGN KEY (DEPTNO) REFERENCES DEPT(DEPTNO) )
```

```
CREATE TABLE DEPT
  (DEPTNO NUMBER,
   DEPTNAME CHAR(10),
   MGRNO NUMBER,
   CONSTRAINT DEPTNO_PK PRIMARY KEY (DEPTNO),
   CONSTRAINT MGRNO_FK FOREIGN KEY (MGRNO) REFERENCES EMP(EMPNO) )
```