

Relational Data Model

(Part 3)

CSI-406 Database Systems



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Relational Data Model cont...

Relational Model Constraints

1. Inherent in the data model called inherent model-based constraints or implicit constraints: a relation cannot have duplicate tuple is inherent constraint.
2. Can be *directly expressed in schema of the data model*, typically by *specifying them in the DDL*, called schema-based constraints or explicit constraints (e.g. Entity integrity constraints and Referential integrity constraints)
3. *Cannot be directly expressed in the schemas of the data model*, and hence **must be expressed and enforced by the application programs**, called application-based or semantic constraints or business rules.

Relational Data Model cont...

Relational Model Constraints

- Elaborating upon **schema-based constraints**:
 1. **Domain Constraints**
 2. **Key Constraints**
 3. **Entity Integrity Constraint**
 4. **Referential Integrity Constraint**

Relational Data Model cont...

Domain Constraints

- Each attribute value must be either **null** (which is really a *non-value*) or ***drawn from the domain of that attribute***.
- Note that some DBMS's allow you to impose the **not null constraint** upon an attribute, which is to say that **no tuple (in the relevant relation) is allowed to have the (non-)value null** in that attribute.

Relational Data Model cont...

Key Constraints

- **Super key of R:** A set of attributes SK of R such that **two tuples in any valid relation instance $r(R)$ will never have the same value for SK.** That is, for any distinct tuples t1 and t2 in r(R), **$t1[SK] \neq t2[SK]$** .
- **Key of R:** A **"minimal" superkey**; that is, a superkey from which **we cannot remove any attributes and still have the uniqueness constraint.**
- **Candidate Key:** A relation may have two or more super keys, **all these super keys will called as candidate keys (to become primary key).**

Relational Data Model cont...

Key Constraints

- **Primary key**: **Successful candidate key** will be called **primary key**. In schema, the **primary key** attributes are **underlined**. The remaining candidate keys are called **Alternate keys**.
- **Example**: The CAR relation schema:
- **CAR** (State, Reg#, SerialNo, Make, Model, Year):
- Has two keys Key1 = {State, Reg#}, Key2 = {SerialNo, Make}, which are also superkeys. {SerialNo, Make} is a superkey but *not* a key.

Relational Data Model cont...

Key Constraints

The CAR relation with two candidate keys:
LicenseNumber and EngineSerialNumber.

CAR	<u>LicenseNumber</u>	EngineSerialNumber	Make	Model	Year
	Texas ABC-739	A69352	Ford	Mustang	96
	Florida TVP-347	B43696	Oldsmobile	Cutlass	99
	New York MPO-22	X83554	Oldsmobile	Delta	95
	California 432-TFY	C43742	Mercedes	190-D	93
	California RSK-629	Y82935	Toyota	Camry	98
	Texas RSK-629	U028365	Jaguar	XJS	98

Relational Data Model cont...

Key Constraints

EMPLOYEE

Schema Diagram for COMPANY relation database Schema

FNAME	MINIT	LNAME	<u>SSN</u>	BDATE	ADDRESS	SEX	SALARY	SUPERSSN	DNO
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DEPARTMENT

Primary keys are underlined

DNAME	<u>DNUMBER</u>	MGRSSN	MGRSTARTDATE
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DEPT_LOCATIONS

<u>DNUMBER</u>	<u>DLOCATION</u>
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PROJECT

PNAME	<u>PNUMBER</u>	PLOCATION	DNUM
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WORKS_ON

<u>ESSN</u>	<u>PNO</u>	HOURS
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DEPENDENT

<u>ESSN</u>	<u>DEPENDENT_NAME</u>	SEX	BDATE	RELATIONSHIP
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Relational Data Model cont...

Entity Integrity Constraint

- **Relational Database Schema:** A set S of relation schemas that belong to the same database. S is the *name* of the **database**. $S = \{R_1, R_2, \dots, R_n\}$
- **Entity Integrity:** The primary key attributes PK of each relation schema R in S **cannot have null values in any tuple of $r(R)$** . This is because primary key values are used to *identify* the individual tuples.
- **$t[PK] \neq \text{null}$ for any tuple t in $r(R)$**

Relational Data Model cont...

Entity Integrity Constraint

- **Note:** Other attributes of R may be similarly constrained to disallow null values, even though they are not members of the primary key (until, unless specified).

Relational Data Model cont...

Referential Integrity Constraint

- A special constraint involving *two* relations, used to specify a ***relationship among tuples in two relations***: the **referencing relation** and the **referenced relation**.
- The previous constraint (i.e. Entity Integrity) involve a *single* relation.

Relational Data Model cont...

Referential Integrity Constraint

- Tuples in the *referencing relation* R_1 have attributes FK (called **foreign key** attributes) that **reference** the **primary key** attributes **PK** of the *referenced relation* R_2 .
- A tuple t_1 in R_1 is said to reference a tuple t_2 in R_2 if $t_1[\text{FK}] = t_2[\text{PK}]$.
- A referential integrity constraint can be displayed in a relational database schema as a directed arc from $R_1.FK$ to R_2 .

Relational Data Model cont...

Referential Integrity Constraint

- **Statement of the constraint:** The value in the foreign key column (or columns) FK of the **referencing relation** R_1 can be either:
 - (1) Same as a value of an **existing primary key value** of the corresponding primary key PK in the **referenced relation** R_2 , or..
 - (2) a null.
- In case (2), the FK in R_1 should not be a part of its own primary key.

Relational Data Model cont...

Referential Integrity Constraint

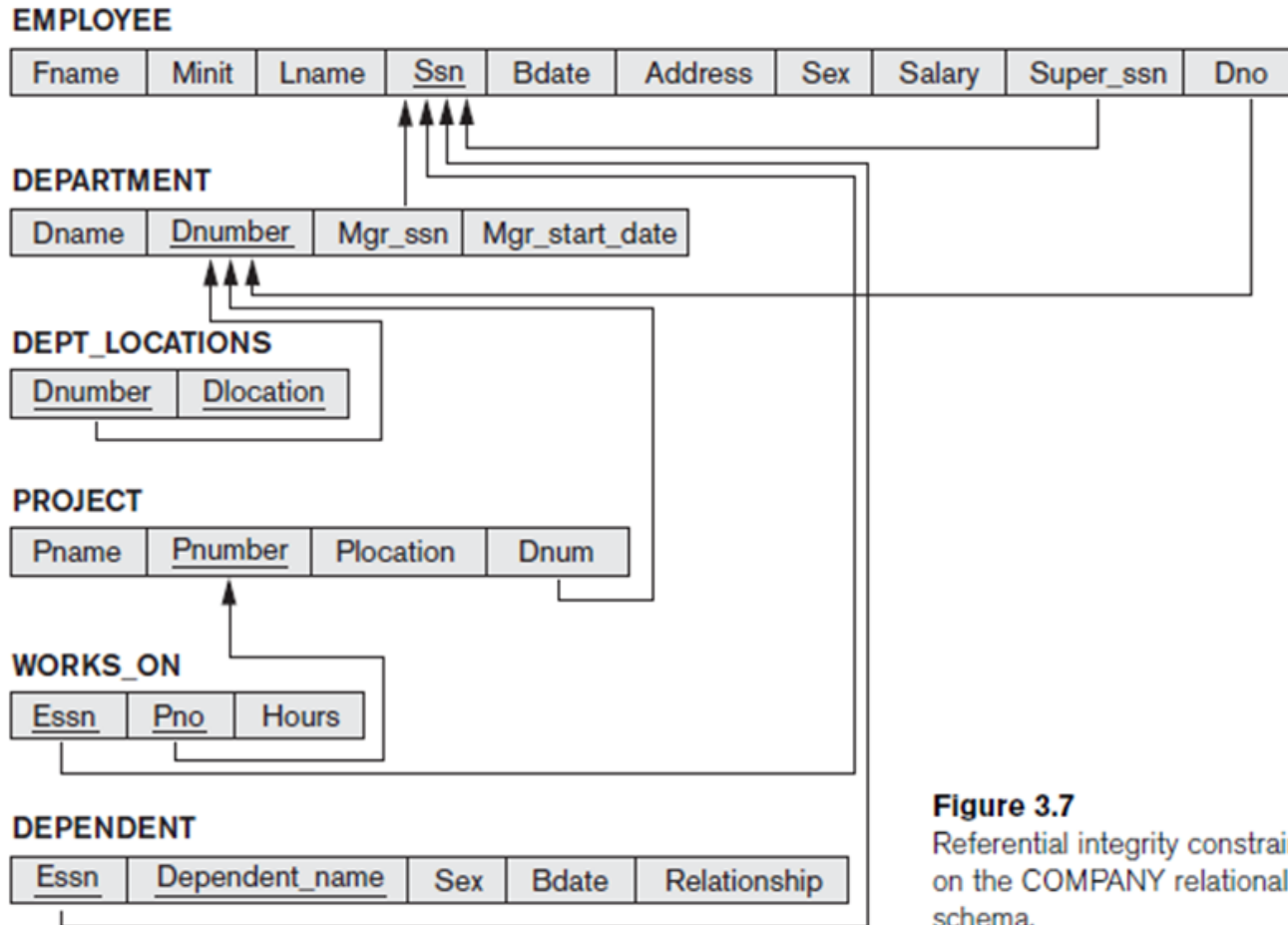


Figure 3.7
Referential integrity constraints displayed on the COMPANY relational database schema.

Relational Data Model cont...

Other Types of Constraints

- **Semantic Integrity Constraints**: based on **application semantics** and cannot be expressed by the data model (or DDL). E.g.,
 - The max. no. of hours per employee for all projects (he or she works on) is 56 hrs per week
 - Salary of a supervisee cannot be greater than that of her/his supervisor
 - Salary of an employee cannot be lowered
 - A department manager cannot be less than 35 years old

Class Assignment

- Consider the following relations for a database that keeps track of student enrollment in courses and the books adopted for each course:
- STUDENT(SSN, Name, Major, Bdate)
- COURSE(Course#, Cname, Dept)
- ENROLL(SSN, Course#, Quarter, Grade)
- BOOK_ADOPTION(Course#, Quarter, Book_ISBN)
- TEXT(Book_ISBN, Book_Title, Publisher, Author)
- **Draw a relational schema diagram specifying the foreign keys for this schema.**