Database Management Systems

Lecture

Relational Model

Contents

- Relational model concepts
- Constraints
- Operations

Relational Model

- What is Cartesian Product of two sets A={a1, a2}, B={b1, b2, b3}?
  - A set of all possible ordered pairs (ai, bi) such that ai is from set A and bi is from set B
  - {

    (a1, b1), (a1, b2), (a1, b3), (a2, b1), (a2, b2), (a2, b3), (a3, b1),

    (a3, b2), (a3, b3)

    }

Relational Model

- Let’s say A = {“Hassan”, “Ali”, “Basit”}, B = {“Lahore, Karachi”}
- What is the Cartesian Product C of A and B (C = A X B)?

  {

  (Hassan, Lahore), (Hassan, Karachi), (Ali, Lahore), (Ali, Karachi),

  (Basit, Lahore), (Basit, Karachi)

  }

- What if we write these pairs in a neat way?

Relational Model

- Let’s say A = {“Hassan”, “Ali”, “Basit”}, B = {“Lahore, Karachi”}
- What is the Cartesian Product C of A and B (C = A X B)?

{
(Hassan, Lahore),
(Hassan, Karachi),
(Ali, Lahore),
(Ali, Karachi),
(Basit, Lahore),
(Basit, Karachi)
}

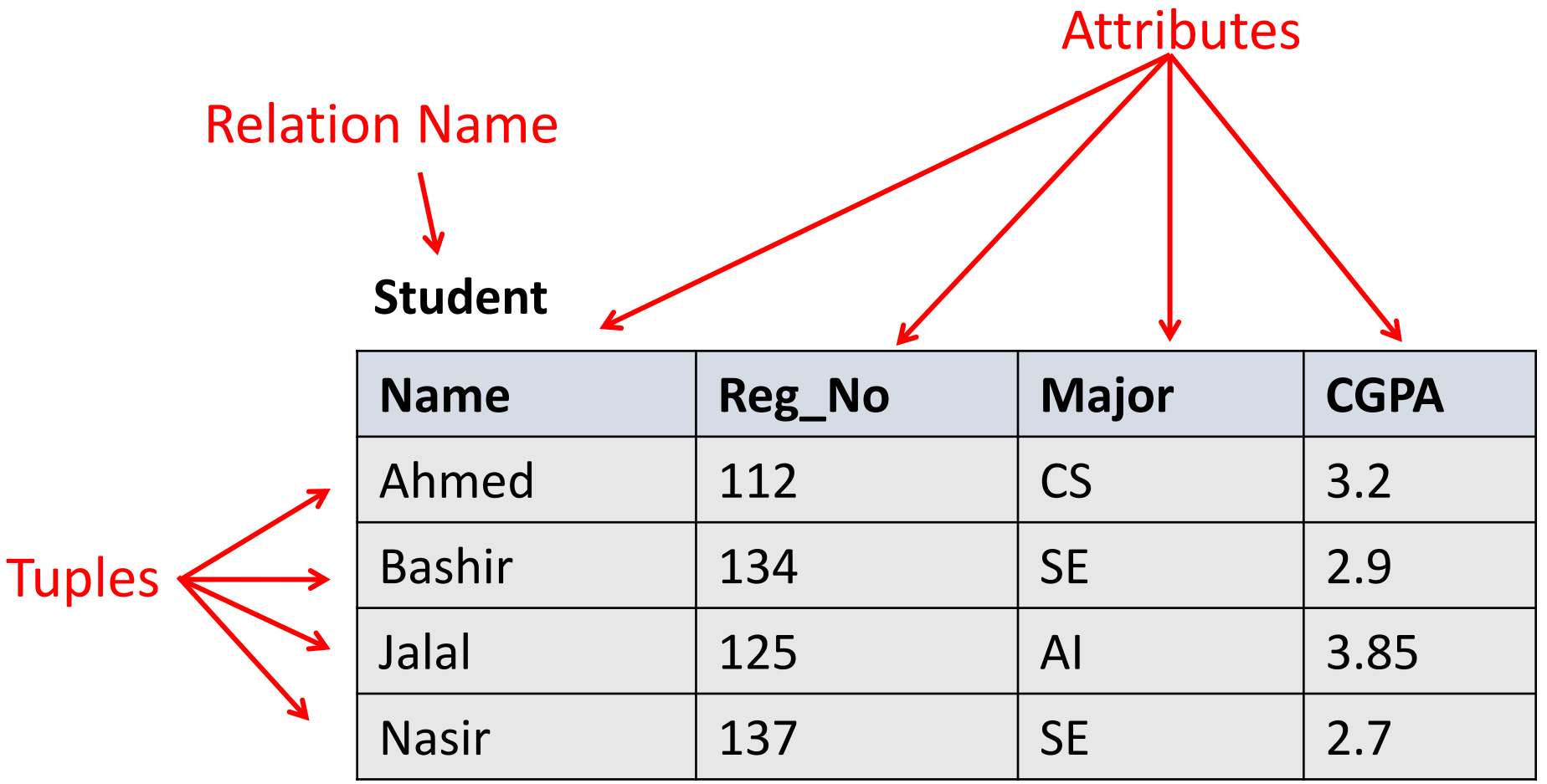
Relational Model

- If we say that set A is domain of an attribute Name, and set B is the domain of attribute City, then what does their Cartesian product represent?
  - A relation! A set of all possible tuples!
  - $R \subset Dom(Name) \times Dom(City)$
- If we have n attributes A1, A2, …, An, and their domains are Dom (A1), Dom (A2), Dom (An), then a relation R is represented by
  - $R \subset Dom(A1) \times Dom(A2) \times \ldots \times Dom(An)$
- Any tuple r from the set R represents an instance of R
  - Denoted as r(R)

Relational Model

- Recall, a relation schema is description of a relation
  - R (A1, A2, … An)
  - n is the degree of relation
- The schema for STUDENT relation could be:
  - STUDENT(Name, RegNo, DateOfBirth, Major, Address, CGPA)
- We can also specify the data type for each attribute
  - STUDENT(Name: String, RegNo: Integer, DateOfBirth: Date, Major:String, Address:String, CGPA:Real)

Relational Model



Name	Reg_No	Major	CGPA
Ahmed	112	CS	3.2
Bashir	134	SE	2.9
Jalal	125	AI	3.85
Nasir	137	SE	2.7

Relational Model Constraints

- **Domain constraints**
  - Values that can be accepted for a given attribute
  - Generally include data type, format
    - Data type: String, Integer, Real Number, Date/Time, etc.
    - Format: (051)1234567, 0321-1234567, etc.
  - NOT NULL
    - Specifies if an attribute can take an empty value
      - ‘Phone’ attribute may be left blank for a particular student if he/she doesn’t have a phone
      - ‘Address’ attribute may be constrained to be NOT NULL – each student must have an address where he/she may be contacted

Relational Model Constraints

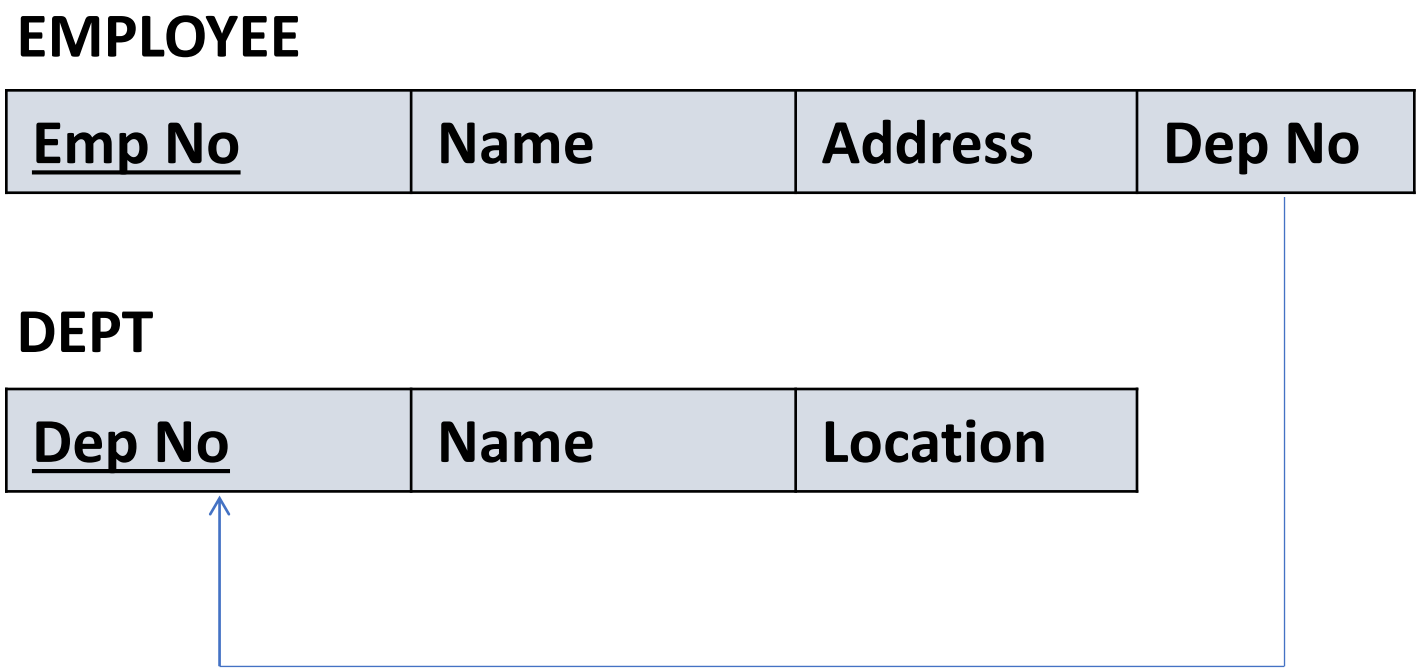
- **Key constraint**
  - There cannot be duplicate values in the primary key of a relation
  - Recall that a key attribute is the one which can be used to uniquely identify an entity, or a tuple, in a relation
  - There may be more than one key attributes (also called candidate keys), but one such attribute is selected as the primary key
  - Primary keys are highlighted by underlining them in the schema
  - STUDENT (<u>RegNo</u>, Name, Address, CGPA)

Relational Model Constraints

- **Entity integrity constraint**
  - No primary key can be NULL!
- **Referential integrity constraint**
  - We first need to define Foreign key
    - A key, or set of keys, that are used to link data between two relations
    - The are used to specify the relationship between two entity types
    - If the primary key of schema R1 is used in another relation R2, then it is called foreign key in R2
    - EMPLOYEE (EmpNo, Name, Address, DNo)
    - DEPT (Dno, Name, Location)
    - DNo is primary key of DEPT but it is foreign key in EMPLOYEE

Relational Model Constraints

- **Foreign key**
  - The foreign key in referencing relation is linked to primary key in referenced relation



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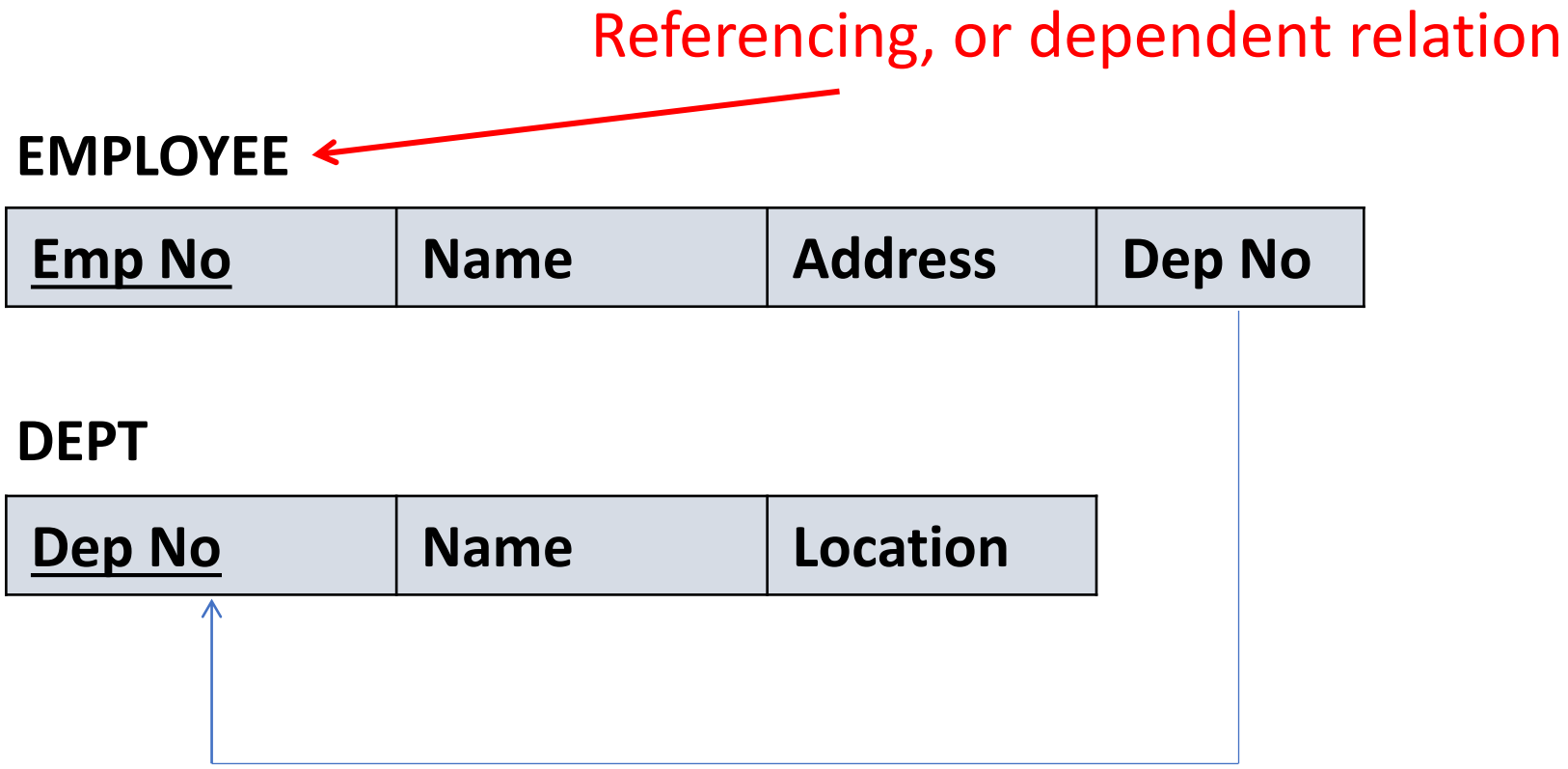

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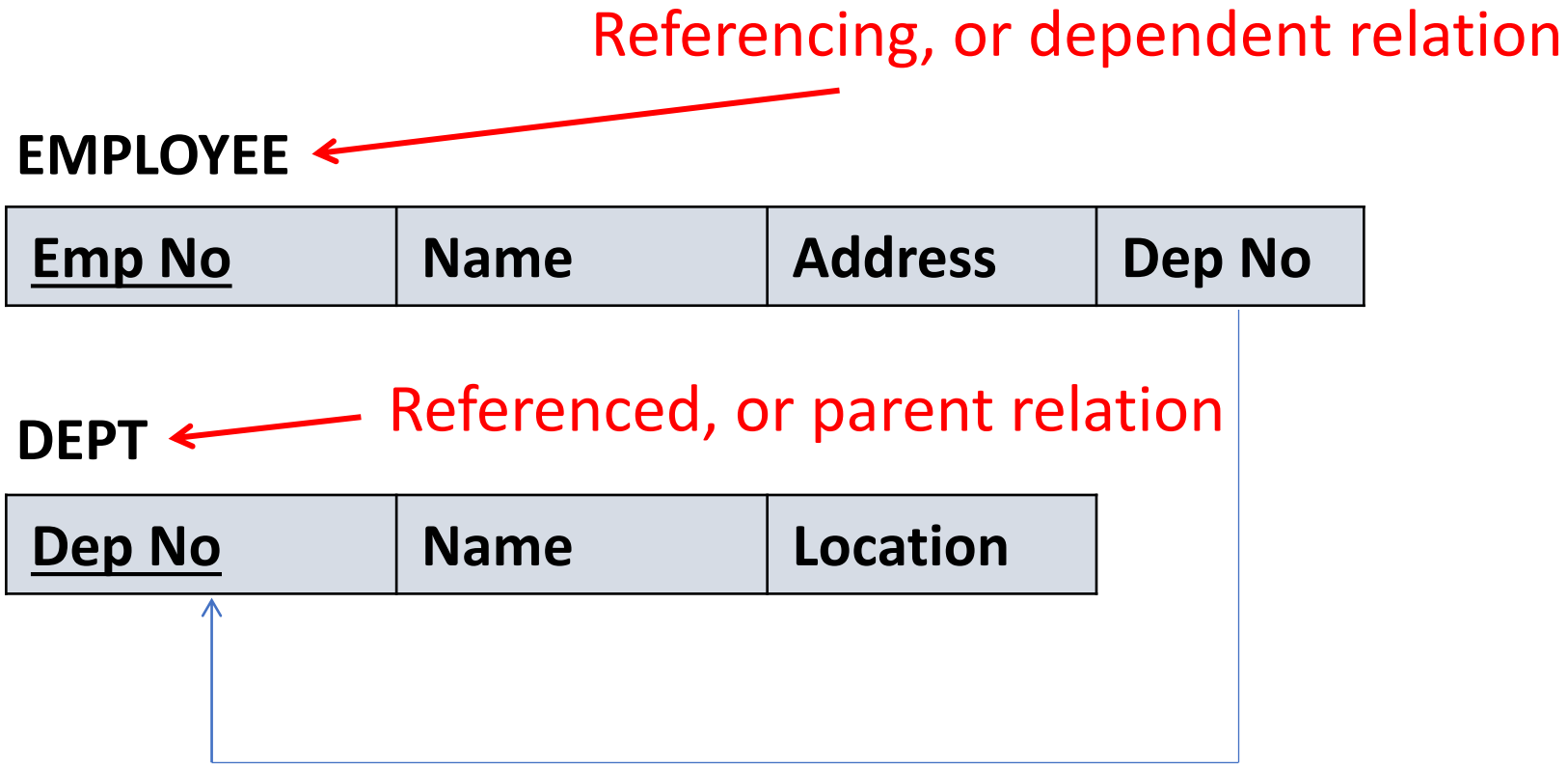

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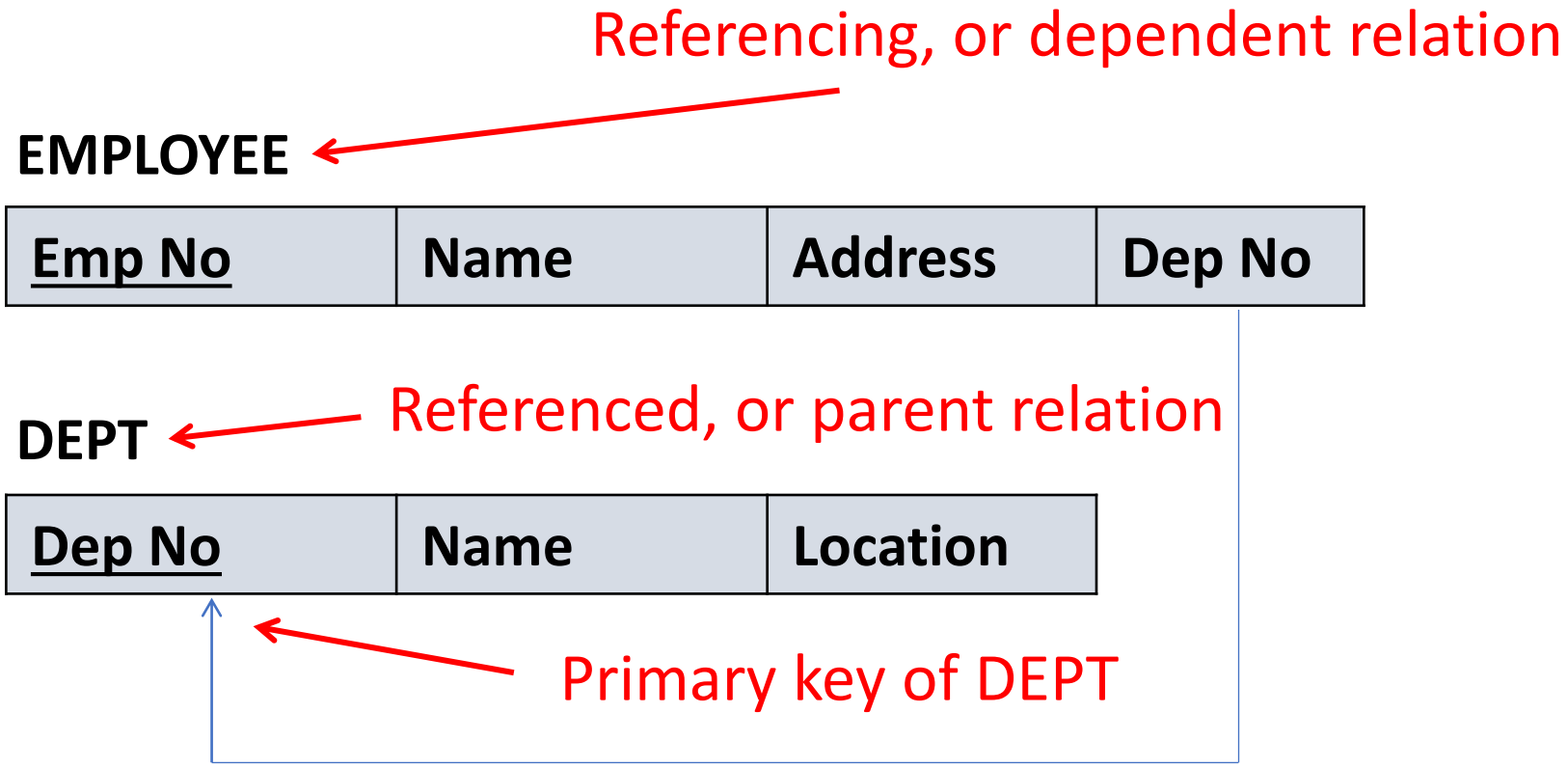

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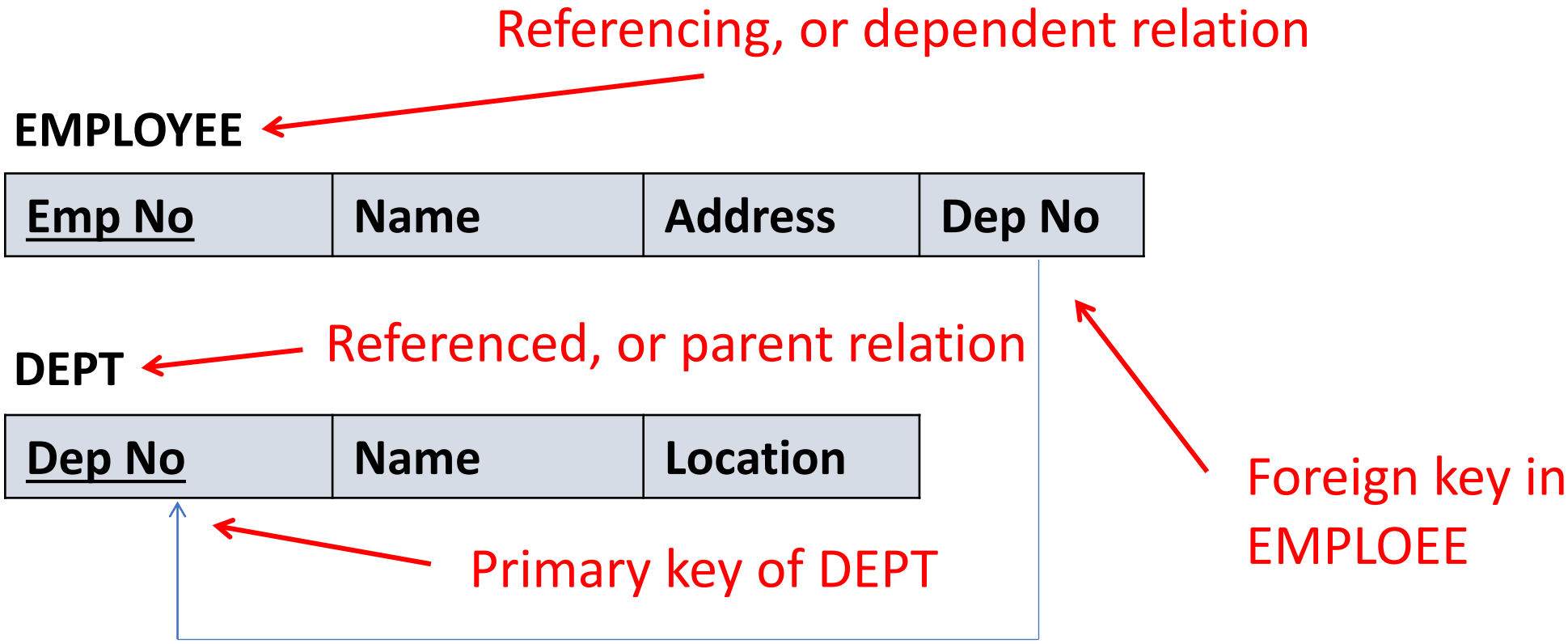

Relational Model Constraints

- **Referential integrity constraint**
  - either each foreign key value must match a primary key value in referencing relation, or it must be NULL

EMPLOYEE

Emp No	**Name**	**Address**	**Dep No**
E_123	John	Street 1	D_23
E_238	Charles	Street 3	NULL
E_124	David	Street 2	D_21

DEPT

Dep No	**Name**	**Location**
D_21	Sales	Los Angeles
D_23	Production	San Francisco

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Is this correct?

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No! This value must be present in the parent table!

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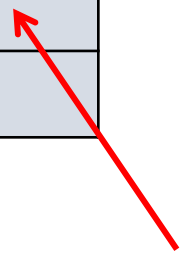

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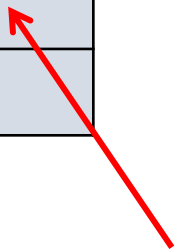

Yes, we may have duplicate values in the foreign key!

Thanks a lot