
Lecture 6: Logical Database Design: ER to Relational

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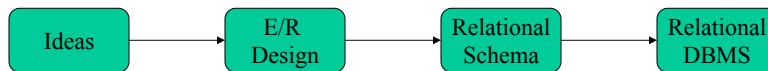
Announcements

- Today:
 - Logical database design:
 - ER to Relational
 - Chapter 3.5 in Ramakrishnan & Gehrke
- Quiz #4 Thursday 10/07/04
 - E/R diagrams and logical database design
 - Ch 2 in Garcia-Molina and 3.5 in Ramakrishnan.

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Introduction

- Entity-Relationship Data Model is very useful in the initial high-level database design
- ER diagram can be translated into a relational database schema
 - Translation is approximate (not all constraints can be captured in SQL)
 - Steps in translation:
 - Entity sets to tables
 - Relationships to tables
 - Constraints
 - Weak entity sets



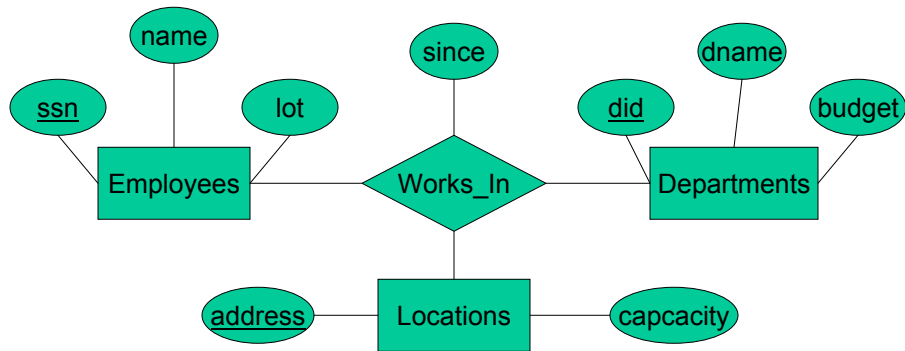
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Example

- We will construct an ER diagram using the following data:
 - A company database contains information about employees, departments and office locations.
 - Each employee has ssn (unique), names and parking lot (lot) attributes.
 - Departments are characterized by department id (did, unique), department name (dname), and budget
 - Each location has an address and capacity and it is uniquely determined by its address.
 - Employees work in departments which have offices in several locations. The time when they started working is also recorded as “since”.

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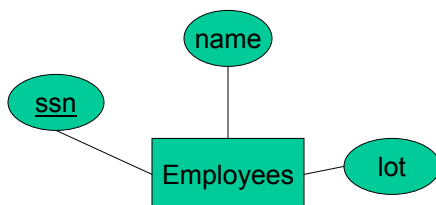
ER Diagram



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Entity Sets to Tables

- Each attribute of the E. S. becomes an attribute of the table
- Example:
 - Employees entity set



```
CREATE TABLE Employees
(ssn CHAR(9),
 name CHAR(20),
 lot INTEGER,
 PRIMARY KEY (ssn))
```

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Relationships to Tables

- In translating a relationship set to a relation, attributes of the relation must include:
 - The primary key for each participating entity set (as foreign keys).
 - This set of attributes forms a *superkey* for the relation.
 - All descriptive attributes of the relationship set

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Example

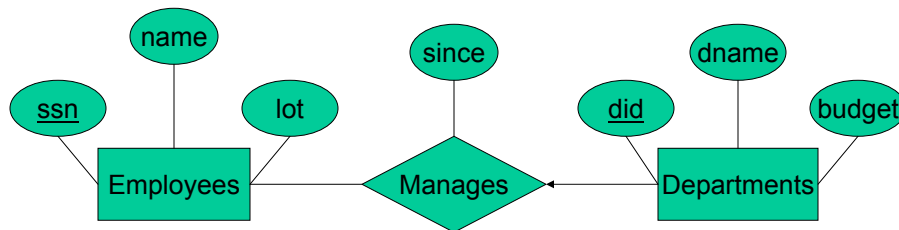
- Works_in relationship set
- Solution:

```
CREATE TABLE Works_In(  
  ssn CHAR(9),  
  did INTEGER,  
  since DATE,  
  address CHAR(40),  
  PRIMARY KEY (ssn, did, address),  
  FOREIGN KEY (ssn) REFERENCES Employees,  
  FOREIGN KEY (did) REFERENCES Departments,  
  FOREIGN KEY (address) REFERENCES Locations)
```

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Relationship Sets with Constraints

- Consider the manages relationship
- Map relationship to a table:
 - Note that *did* is the key now!
 - Separate tables for Employees and Departments.
- Since each department has a unique manager, we could instead combine Manages and Departments.



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SQL Tables

- Solution:

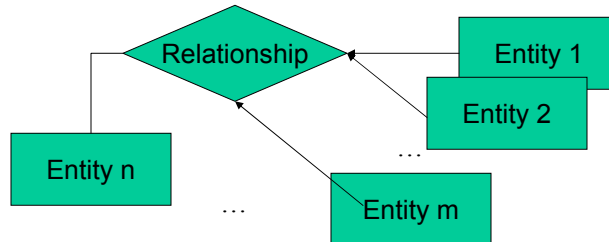
```
CREATE TABLE Manages(  
  ssn CHAR(9),  
  did INTEGER,  
  since DATE,  
  PRIMARY KEY (did),  
  FOREIGN KEY (ssn)  
    REFERENCES Employees,  
  FOREIGN KEY (did)  
    REFERENCES Departments)
```
- Since each department has a unique manager, we could instead combine Manages and Departments.
- Solution

```
CREATE TABLE Dept_Mgr(  
  did INTEGER,  
  dname CHAR(20),  
  budget REAL,  
  manager CHAR(9),  
  since DATE,  
  PRIMARY KEY (did),  
  FOREIGN KEY (manager)  
    REFERENCES Employees)
```

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General case

- A relationship with n entity sets and some m of them have one-to-one or one-to-many constraints (arrows in the E/R diagram)

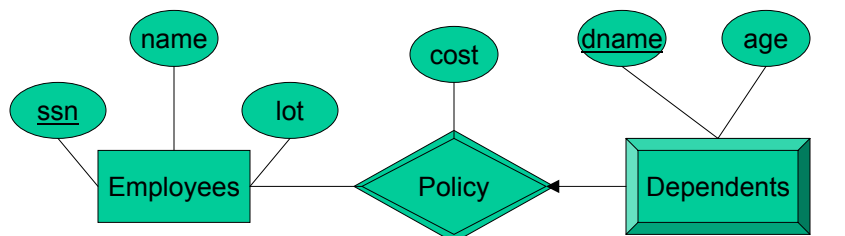


- The key for any of m entity sets is a candidate key for the relation
- One of them should be designated as the primary key.

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Weak Entities

- A *weak entity* can be identified uniquely only by considering the primary key of another (*owner*) entity.
 - Owner entity set and weak entity set must participate in a one-to-many relationship set (1 owner, many weak entities).
 - Weak entity set must have total participation in this *identifying* relationship set.



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Translating weak entities

- Weak entity set and identifying relationship set are translated into a single table --- it has a (1,1) cardinality constraint.

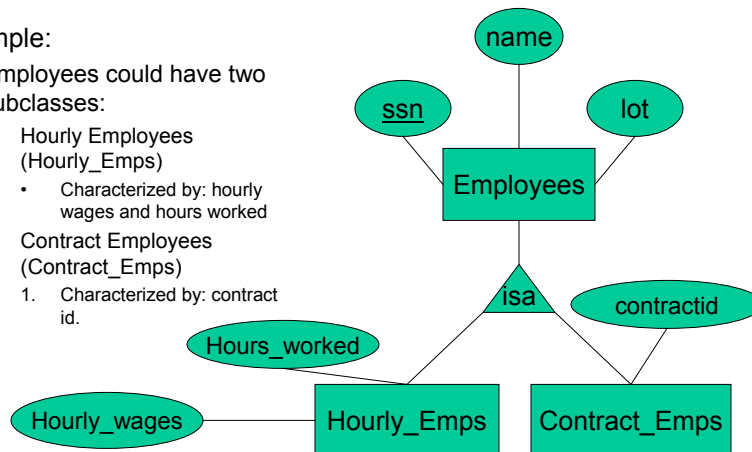
```
CREATE TABLE Dep_Policy (  
  dname CHAR(20),  
  age INTEGER,  
  cost REAL,  
  parent_ssn CHAR(9) NOT NULL,  
  PRIMARY KEY (dname, parent_ssn),  
  FOREIGN KEY (parent_ssn) REFERENCES Employees,  
  ON DELETE CASCADE)
```

- When an owner entity is deleted all owned entity should also be deleted.

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Translating Class Hierarchies

- Example:
 - Employees could have two subclasses:
 - Hourly Employees (Hourly_Emps)
 - Characterized by: hourly wages and hours worked
 - Contract Employees (Contract_Emps)
 - Characterized by: contract id.



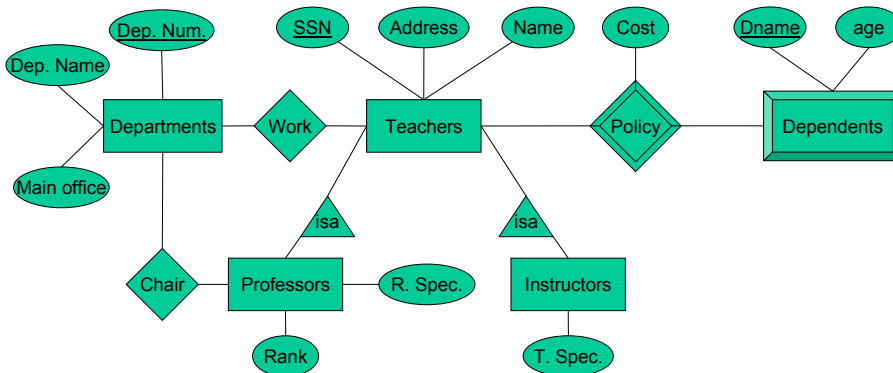
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Translating Class Hierarchies

- Two approaches
 - Three tables: Employees, Hourly_Emps and Contract_Emps.
 - *Hourly_Emps*: Every employee is recorded in Employees. For hourly emps, extra info recorded in Hourly_Emps (*hourly_wages*, *hours_worked*, *ssn*);
 - We must delete Hourly_Emps tuple if referenced Employees tuple is deleted).
 - Queries involving all employees easy, those involving just Hourly_Emps require a join to get some attributes.
 - Alternative: Just Hourly_Emps and Contract_Emps.
 - *Hourly_Emps*: *ssn*, *name*, *lot*, *hourly_wages*, *hours_worked*.
 - Each employee must be in one of these two subclasses.

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Example



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Homework

- Read Ch 3.5. In Ramakrishnan