# *CS122A: Introduction to Data Management*

## *Lecture #5*
## *(E-R→Relational, Cont.)*

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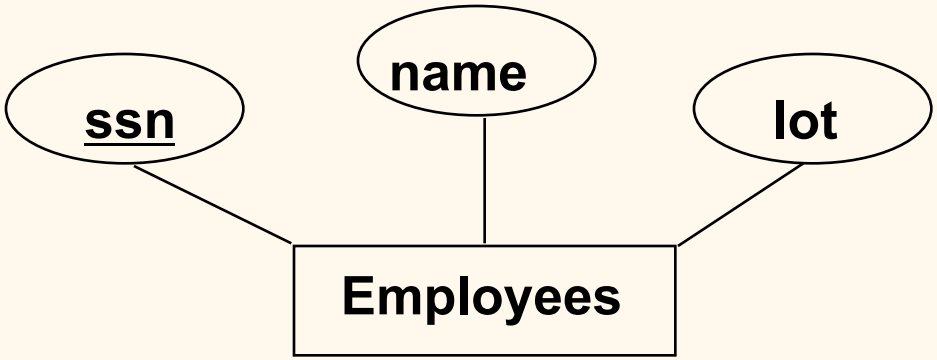
# *Logical DB Design: ER to Relational (Review)*

- Entity sets to tables:

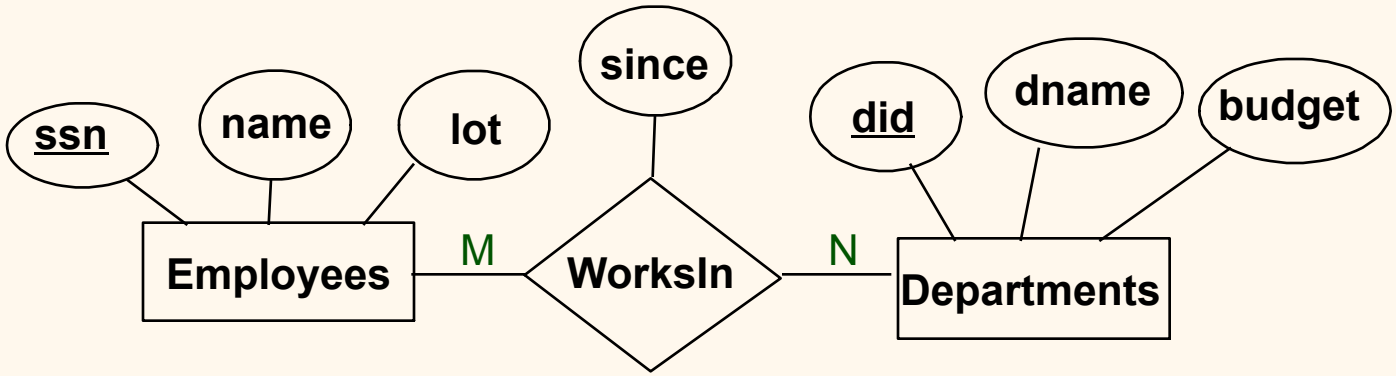



```
CREATE TABLE Employees
    (ssn CHAR(11),
    name CHAR(20),
    lot  INTEGER,
    PRIMARY KEY  (ssn))
```

# *Relationship Sets to Tables (Review)*

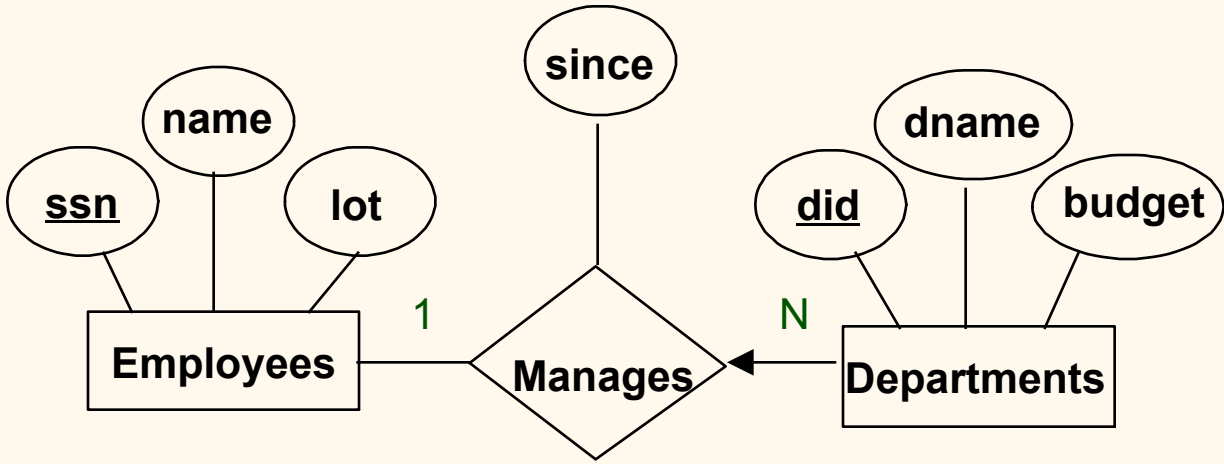
- In translating a relationship set to a relation, attributes of the relation must include:
  - Keys for each participating entity set (as foreign keys).
    - Note: This set of attributes forms a *superkey* for the relation.
  - All descriptive attributes.

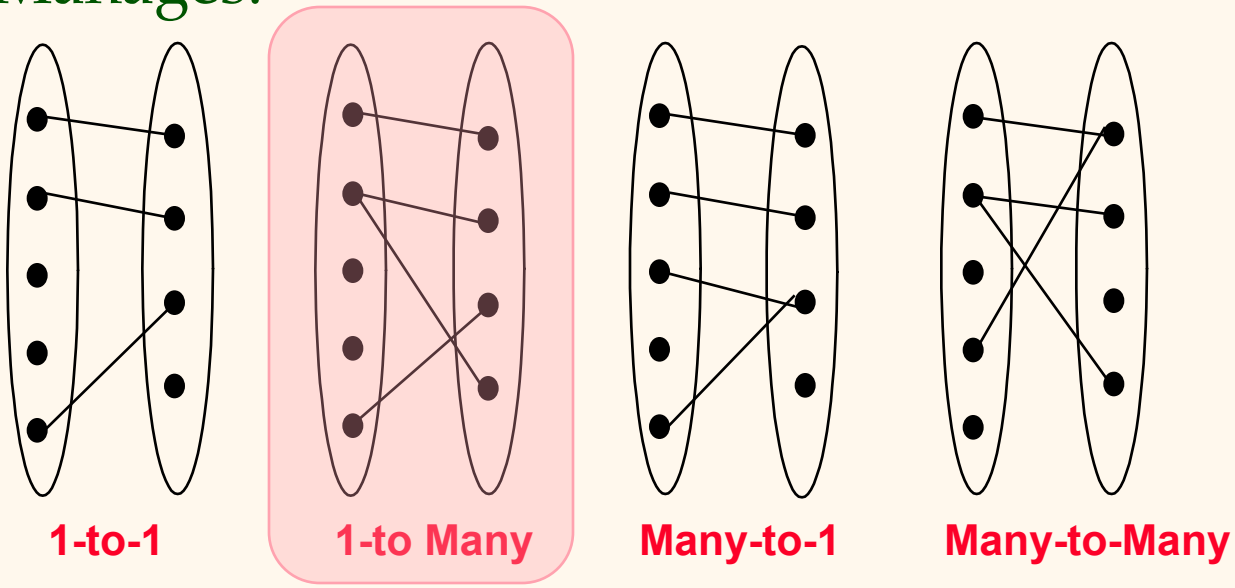
```
CREATE TABLE Works_In(
  ssn  CHAR(11),
  did  INTEGER,
  since  DATE,
  PRIMARY KEY (ssn, did),
  FOREIGN KEY (ssn)
     REFERENCES Employees,
  FOREIGN KEY (did)
     REFERENCES Departments)
```



# *Key Constraints (Review)*

- Each dept has at most one manager, according to the *key constraint* on Manages.




*Translation to relational model?*

# *Translating ER Diagrams with Key Constraints*

- Map the relationship to a table (Manages):
  - Note that did is the key now!
  - Separate tables for Employees and Departments.
- But, since *each* department has a *unique* manager, we could choose to fold Manages right into Departments.

***(Q: Why do that...?)***

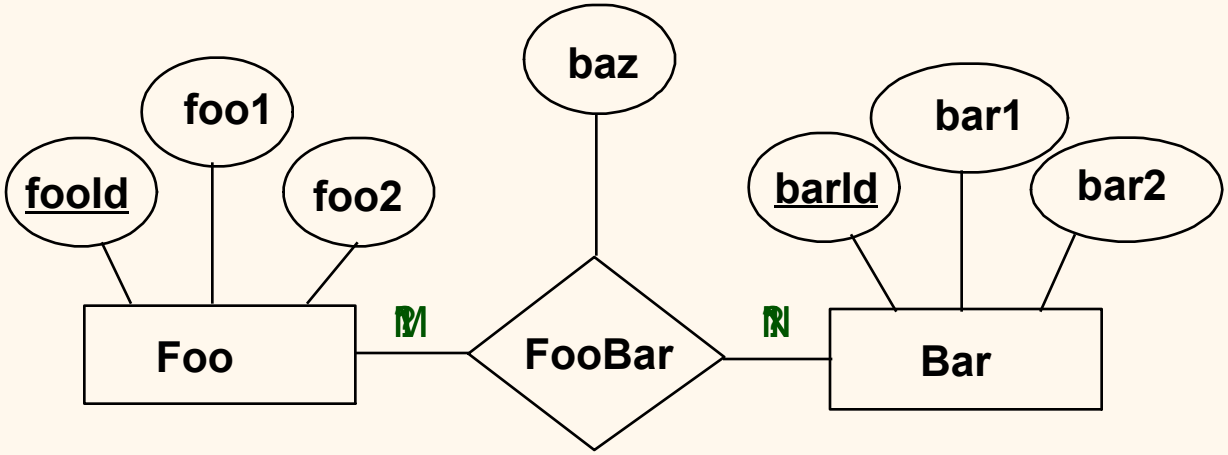
```
CREATE TABLE Manages (
  ssn CHAR(11),
  did INTEGER,
  since DATE,
  PRIMARY KEY (did),
  FOREIGN KEY (ssn) REFERENCES Employees,
  FOREIGN KEY (did) REFERENCES Departments)
```

*vs.*

```
CREATE TABLE Departments2 (
  did INTEGER,
  dname CHAR(20),
  budget REAL,
  mgr_ssn CHAR(11),
  mgr_since DATE,
  PRIMARY KEY (did),
  FOREIGN KEY (mgr_ssn) REFERENCES Employees)
```

***Note**: The relationship info has been pushed to the N-side's entity table!*

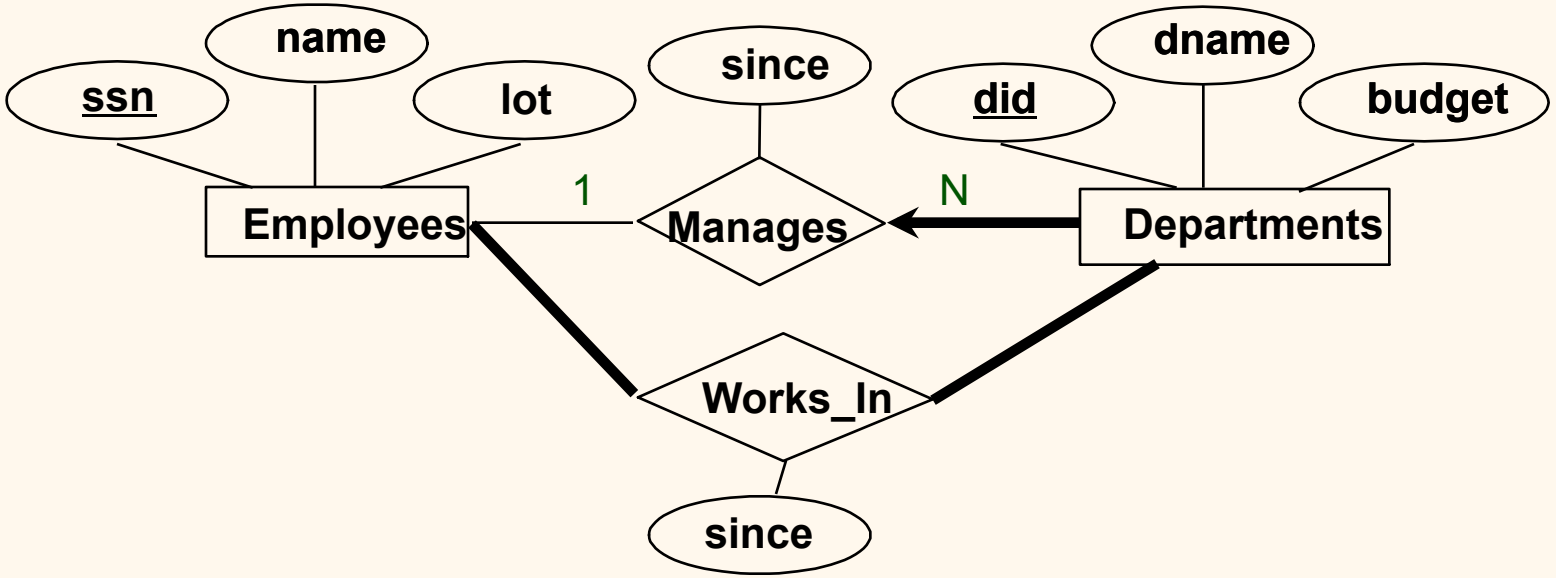
# *Properly Reflecting Key Constraints*




- So what are the translated relationship table keys (*etc.*) when…
  - FooBar is M:N? → FooBar(<u>fooId, barId</u>, baz)
  - FooBar is N:1? → FooBar(<u>fooId</u>, barId, baz)
  - Foobar is 1:N? → FooBar(fooId, <u>barId</u>, baz)
  - Foobar is 1:1? → FooBar(<u>fooId, barId</u>, baz) *(Note: <u>unique</u>)*

# *Review: Participation Constraints*

- Does every department have a manager?
  - If so, this is a *participation constraint*: the participation of Departments in Manages is said to be *total* (vs. *partial*).
    - Every *did* value in Departments table must appear in a row of the Manages table (with a non-null *ssn* value!!)



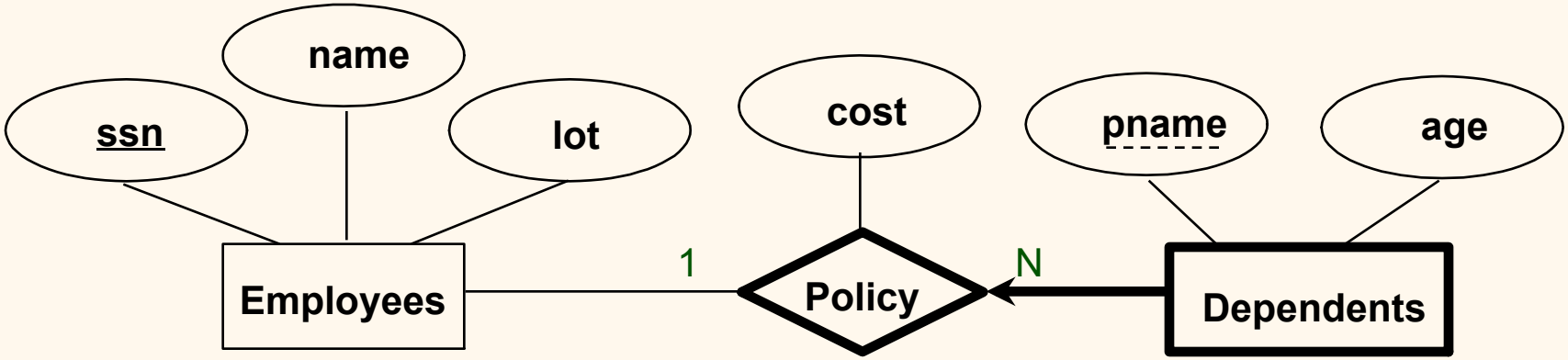
# *Participation Constraints in SQL*

- We can capture participation constraints involving one entity set in a binary relationship, but little else (without resorting to the use of *triggers*).

```
CREATE TABLE Department2 (
   did INTEGER,
   dname CHAR(20),
   budget REAL,
   mgr_ssn CHAR(11) NOT NULL,
   mgr_since DATE,
   PRIMARY KEY (did),
   FOREIGN KEY (mgr_ssn) REFERENCES Employees,
      ON DELETE NO ACTION)
```

# *Review: 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.

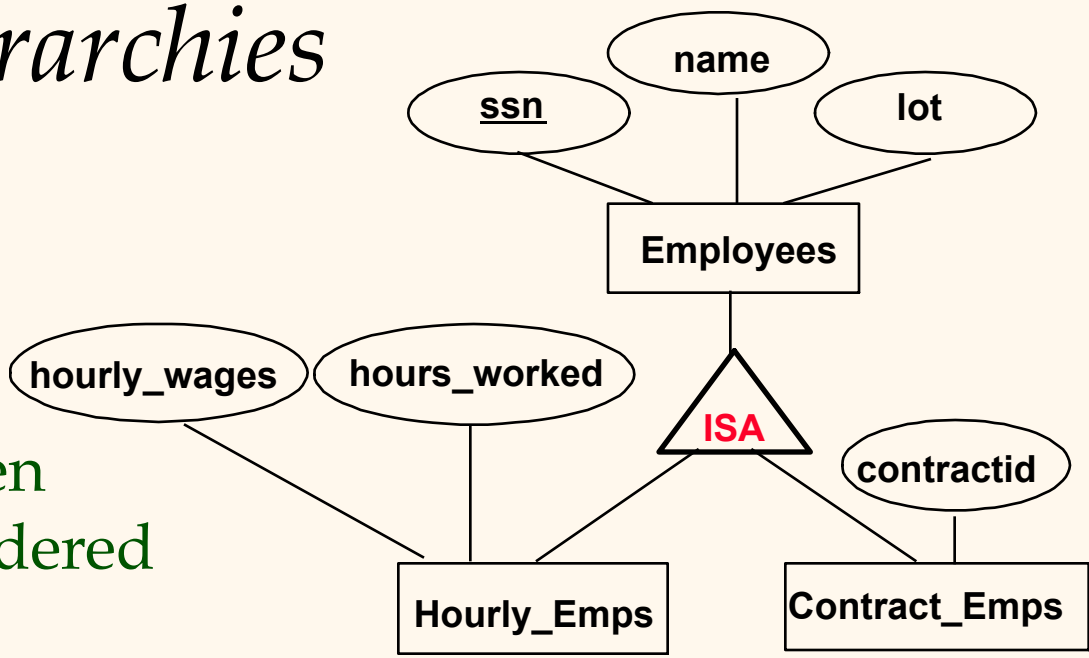


# *Translating Weak Entity Sets*

- Weak entity set and identifying relationship set are translated into a single table.
  - When the owner entity is deleted, all owned weak entities must also be deleted.

```
CREATE TABLE Dependents2 (
   pname CHAR(20),
   age INTEGER,
   cost REAL,
   ssn CHAR(11) NOT NULL,
   PRIMARY KEY (pname, ssn),
   FOREIGN KEY (ssn) REFERENCES Employees,
      ON DELETE CASCADE)
```

# *Review: ISA Hierarchies*




- As in C++, or other PLs, attributes are inherited.
- If we declare A **ISA** B, then every A entity is also considered to be a B entity.

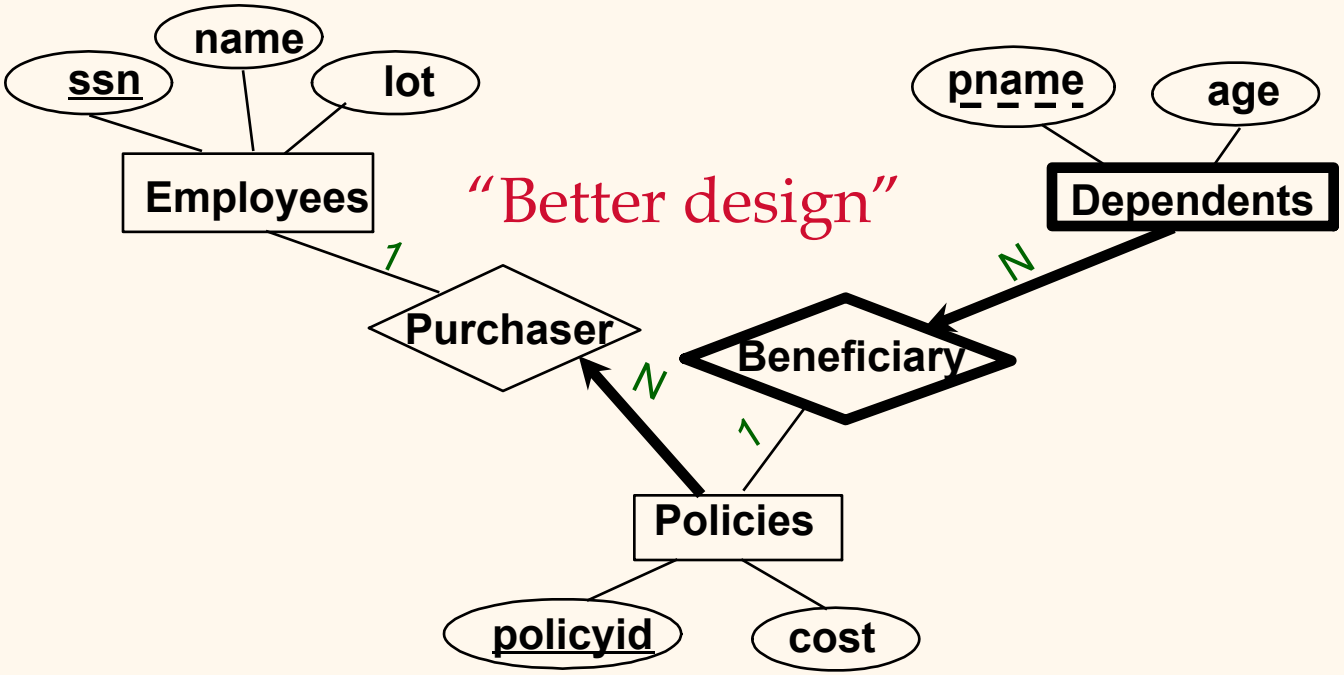
- *Overlap constraints*: Can Joe be an Hourly_Emps as well as a Contract_Emps entity? (*Allowed/disallowed*)
- *Covering constraints*: Does every Employees entity also have to be an Hourly_Emps or a Contract_Emps entity? *(Yes/no)*

# *Translating ISA Hierarchies to Relations*

- ***Most general approach:***
  - 3 relations: Employees, Hourly_Emps and Contract_Emps.
    - *Hourly_Emps*: Every employee recorded in Employees. For hourly emps, *extra* info recorded in Hourly_Emps (*hourly_wages*, *hours_worked*, *ssn*); delete Hourly_Emps tuple if referenced Employees tuple is deleted.
    - Queries about all employees easy; those involving just Hourly_Emps require a join to get the extra attributes.
- An alternative: Hourly_Emps and Contract_Emps.
  - *Hourly_Emps*: *ssn*, *name*, *lot*, *hourly_wages*, *hours_worked*.
  - Each employee must be in one of these two subclasses.

  *(Q: Can we always do this, then? A: Not w/o redundancy!)*

# *Review: Binary vs. Ternary Relationships*



# *Binary vs. Ternary Relationships (Contd.)*

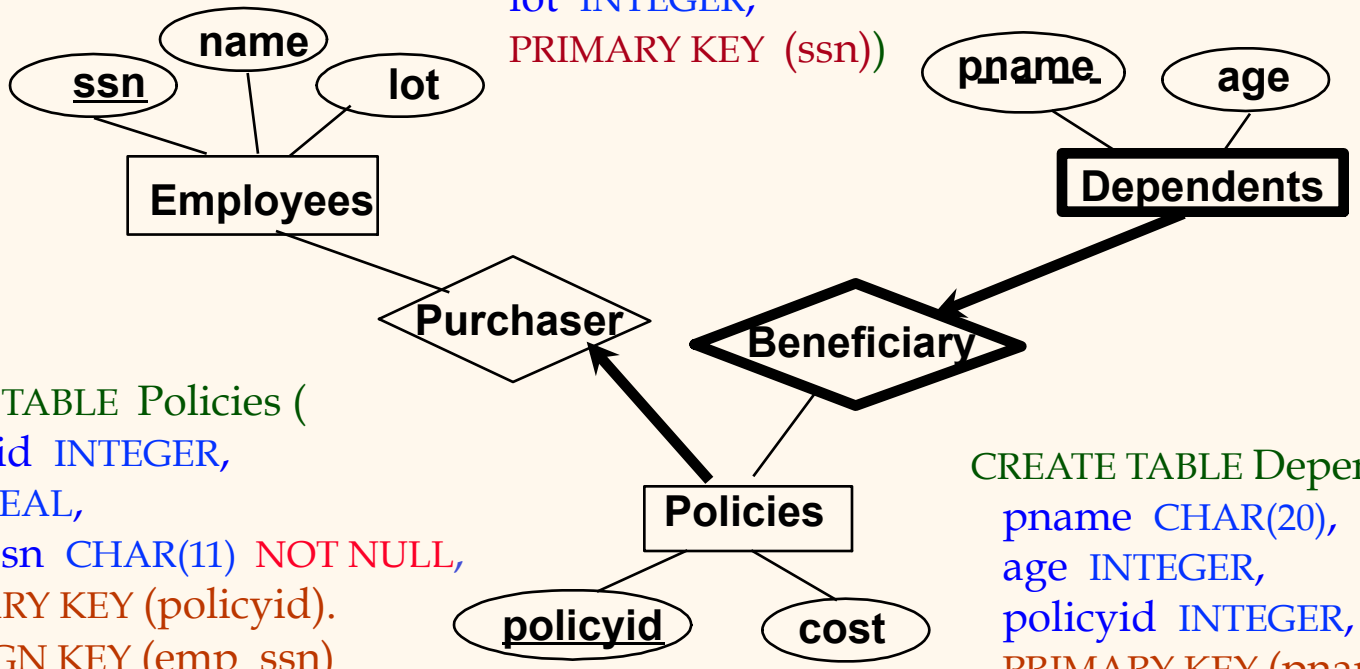
- The key constraints let us combine *Purchaser with Policies* and *Beneficiary with Dependents*.
- Participation constraints lead to NOT NULL constraints.
  (*Note:* Primary key attributes are NOT NULL as well – check documentation to see if that's implicit or explicit!

```
CREATE TABLE Policies (
  policyid INTEGER,
  cost REAL,
  emp_ssn CHAR(11) NOT NULL,
  PRIMARY KEY (policyid).
  FOREIGN KEY (emp_ssn) REFERENCES Employees
     ON DELETE CASCADE)
```

```
CREATE TABLE Dependents (
  pname CHAR(20),
  age INTEGER,
  policyid INTEGER,
  PRIMARY KEY (pname, policyid),
  FOREIGN KEY (policyid) REFERENCES Policies
     ON DELETE CASCADE)
```

# *Review: Binary vs. Ternary Relationships*

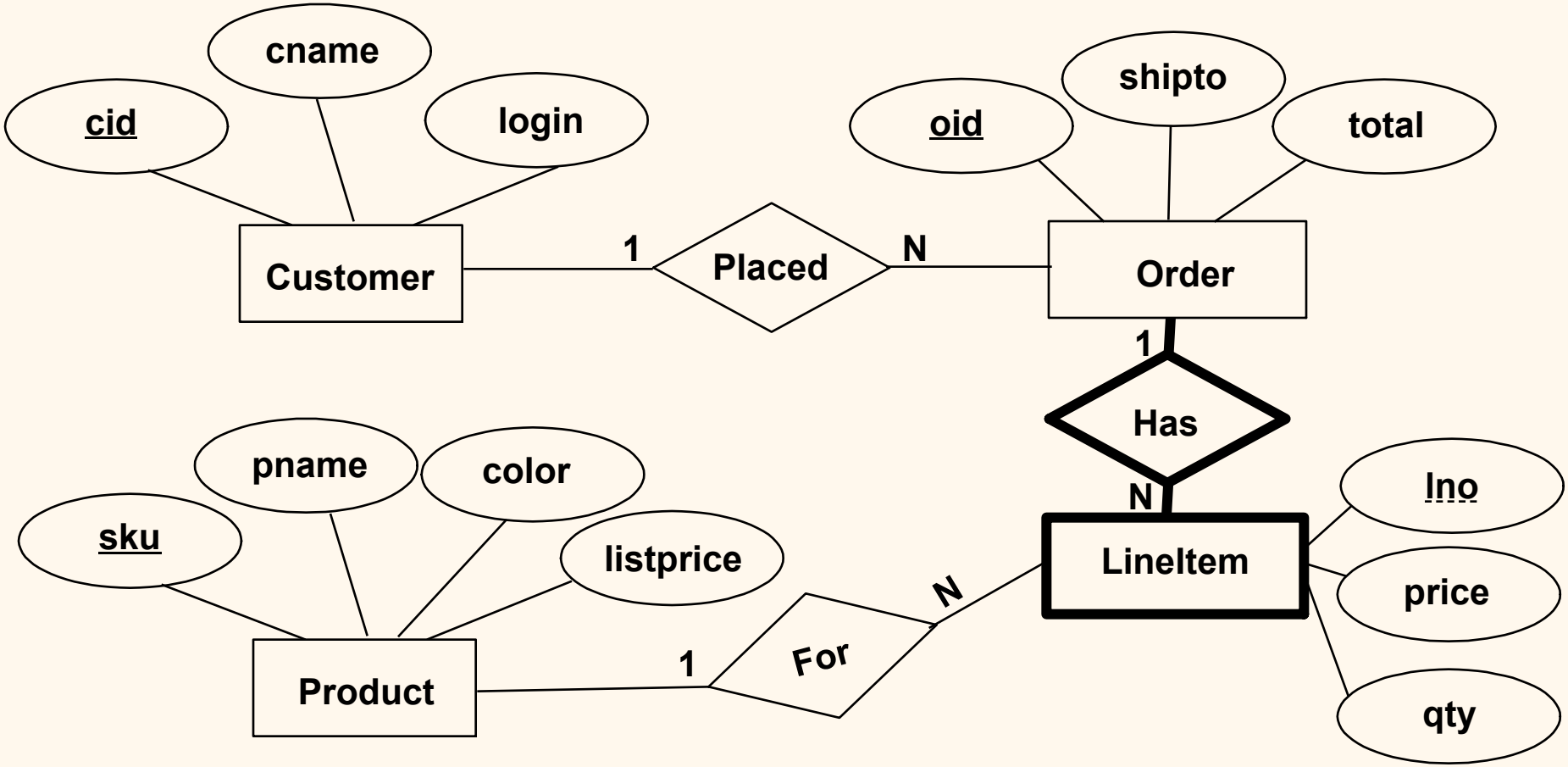
```
CREATE TABLE Employees (
  ssn CHAR(11),
  name CHAR(20),
  lot INTEGER,
  PRIMARY KEY (ssn))
```




```
CREATE TABLE Policies (
  policyid INTEGER,
  cost REAL,
  emp_ssn CHAR(11) NOT NULL,
  PRIMARY KEY (policyid).
  FOREIGN KEY (emp_ssn)
     REFERENCES Employees
     ON DELETE CASCADE)
```

```
CREATE TABLE Dependents (
  pname CHAR(20),
  age INTEGER,
  policyid INTEGER,
  PRIMARY KEY (pname, policyid),
  FOREIGN KEY (policyid)
     REFERENCES Policies
     ON DELETE CASCADE)
```

# *An Example: Putting It Together*



# *Putting It Together (Cont'd.)*

```
CREATE TABLE Customer (
   cid INTEGER,
   cname VARCHAR(50),
   login VARCHAR(20)
      NOT NULL,
   PRIMARY KEY (cid),
    UNIQUE (login))

CREATE TABLE Product (
   sku INTEGER,
   pname VARCHAR(100),
   color VARCHAR(20),
   listprice DECIMAL(8,2),
   PRIMARY KEY (sku))
```

```
CREATE TABLE Order (
   oid INTEGER,
   custid INTEGER,
   shipto VARCHAR(200),
   total DECIMAL(8,2),
   PRIMARY KEY (oid),
   FOREIGN KEY (custid) REFERENCES Customer))

CREATE TABLE LineItem (
   oid INTEGER,
   lno INTEGER,
   price DECIMAL(8,2),
   qty INTEGER,
    sku INTEGER,
   PRIMARY KEY (oid, lno),
   FOREIGN KEY (oid) REFERENCES Order
        ON DELETE CASCADE),
   FOREIGN KEY (sku) REFERENCES Product))
```

# *Putting It Together (Cont'd.)*

Customer

| cid | cname | login |
|---|---|---|
| 1 | Smith, James | jsmith@aol.com |
| 2 | White, Susan | suzie@gmail.com |
| 3 | Smith, James | js@hotmail.com |

Product

| sku | pname | color | listprice |
|---|---|---|---|
| 123 | Frozen DVD | null | 24.95 |
| 456 | Graco Twin Stroller | green | 199.99 |
| 789 | Moen Kitchen Sink | black | 350.00 |

Order

| oid | custid | shipto | total |
|---|---|---|---|
| 1 | 3 | J. Smith, 1 Main St., USA | 199.95 |
| 2 | 1 | Mrs. Smith, 3 State St., USA | 300.00 |

LineItem

| oid | lno | price | qty | item |
|---|---|---|---|---|
| 1 | 1 | 169.95 | 1 | 456 |
| 1 | 2 | 15.00 | 2 | 123 |
| 2 | 1 | 300.00 | 1 | 789 |

# *SQL Views*

- A *view* is just a relation, but we store its *definition* rather than storing the (materialized) set of tuples.

```
CREATE VIEW YoungActiveStudents (name, grade)
        AS SELECT S.name, E.grade
        FROM Students S, Enrolled E
        WHERE S.sid = E.sid and S.age < 21
```

- Views can be dropped using the DROP VIEW command.
  - How to handle DROP TABLE if there's a view on the table?
    - DROP TABLE command has options to let the user specify this.

# *Views and Security*

- Views can be used to present necessary information (or a summary) while hiding some details in underlying relation(s).
  - Given YoungStudents, but not Students or Enrolled, we can find students *S* who have are enrolled, but not the *cid's* of the courses they are enrolled in.

# *Relational Model and E-R Schema Translation: Summary*

- A tabular representation of data.
- Simple and intuitive, also widely used.
- Integrity constraints can be specified by the DBA based on application semantics. DBMS then checks for violations.
  - Two important ICs: Primary and foreign keys (PKs, FKs).
  - In addition, we *always* have domain constraints.
- Powerful and natural query languages exist (soon!)
- Rules to translate E-R to relational model
  - Can be done by a human, or automatically (using a tool)