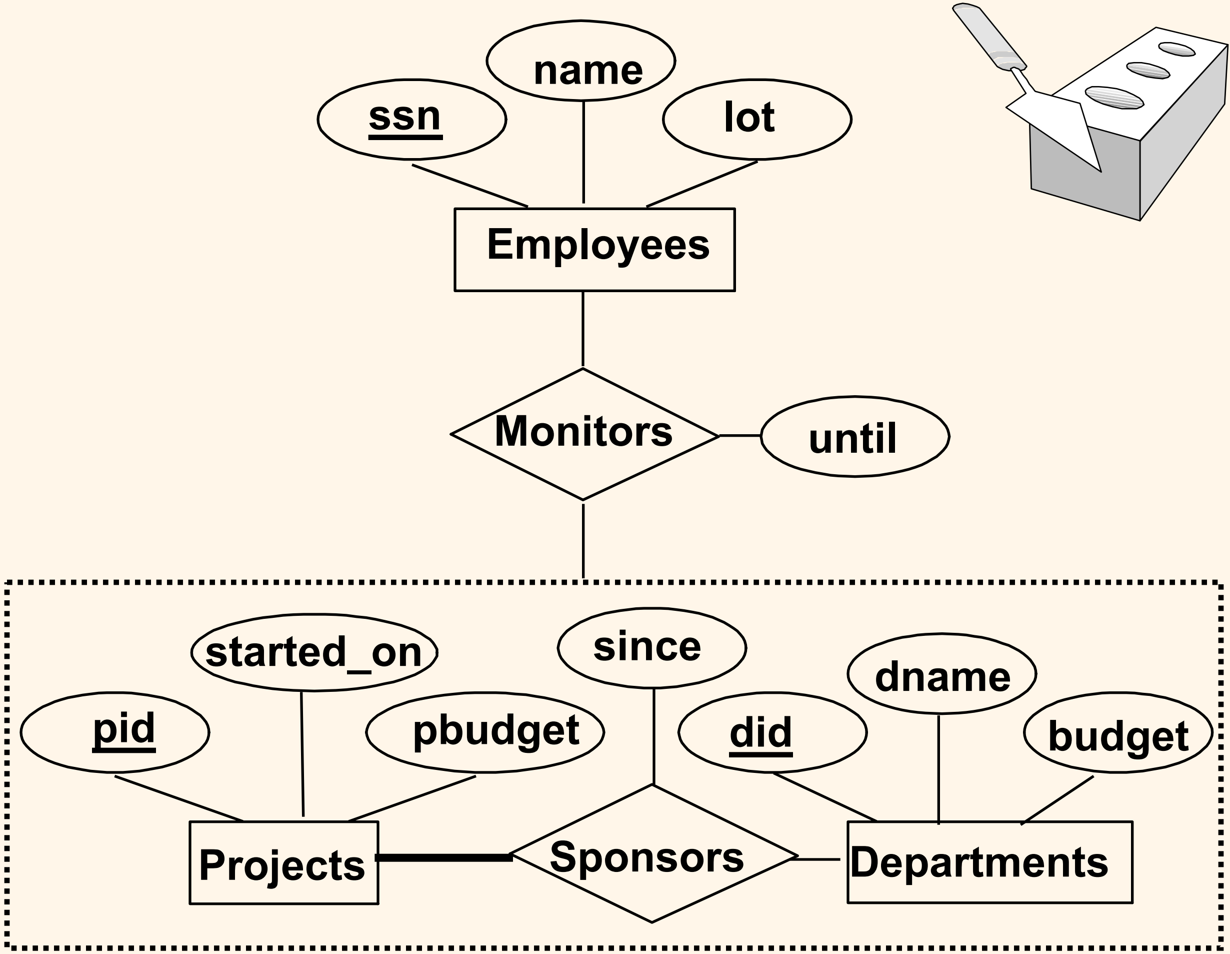
The Entity-Relationship Model

Chapter 2

Aggregation

- Used when we have to model a relationship involving entity sets and a *relationship set*.
  - *Aggregation* allows us to treat a relationship set as an entity set for purposes of participation in (other) relationships.



☛ *Aggregation vs. ternary relationship:*

- Monitors is a distinct relationship, with a descriptive attribute.
- Also, can say that each sponsorship is monitored by at most one employee.

Conceptual Design Using the ER Model

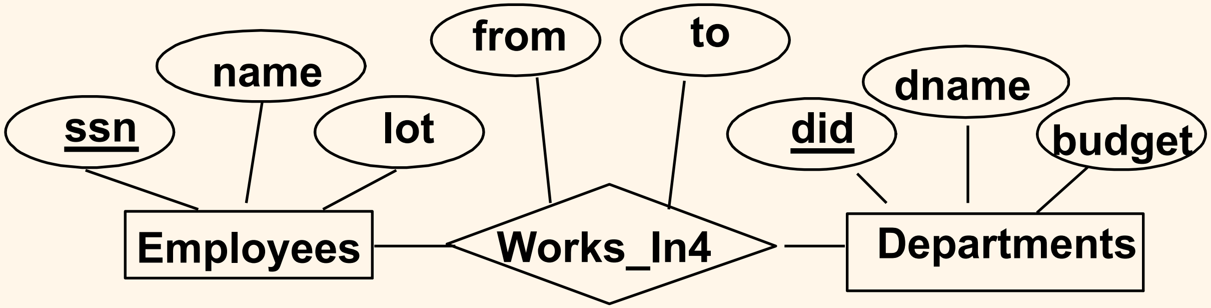
- Design choices:
  - Should a concept be modeled as an entity or an attribute?
  - Should a concept be modeled as an entity or a relationship?
  - Identifying relationships: Binary or ternary? Aggregation?
- Constraints in the ER Model:
  - A lot of data semantics can (and should) be captured.
  - But some constraints cannot be captured in ER diagrams.

Entity vs. Attribute

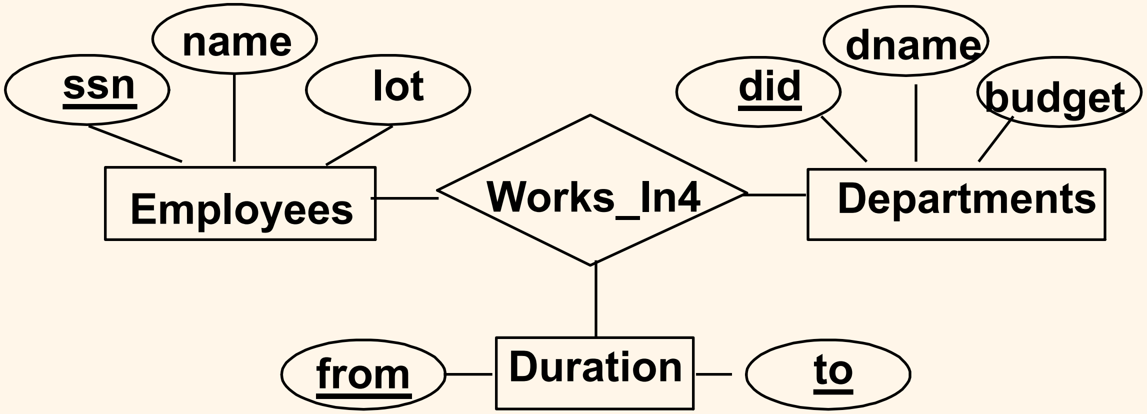
- Should *address* be an attribute of Employees or an entity (connected to Employees by a relationship)?
- Depends upon the use we want to make of address information, and the semantics of the data:
  - If we have several addresses per employee, *address* must be an entity (since attributes cannot be set-valued).
  - If the structure (city, street, etc.) is important, e.g., we want to retrieve employees in a given city, *address* must be modeled as an entity (since attribute values are atomic).

Entity vs. Attribute (Contd.)

- Works_In4 does not allow an employee to work in a department for two or more periods.

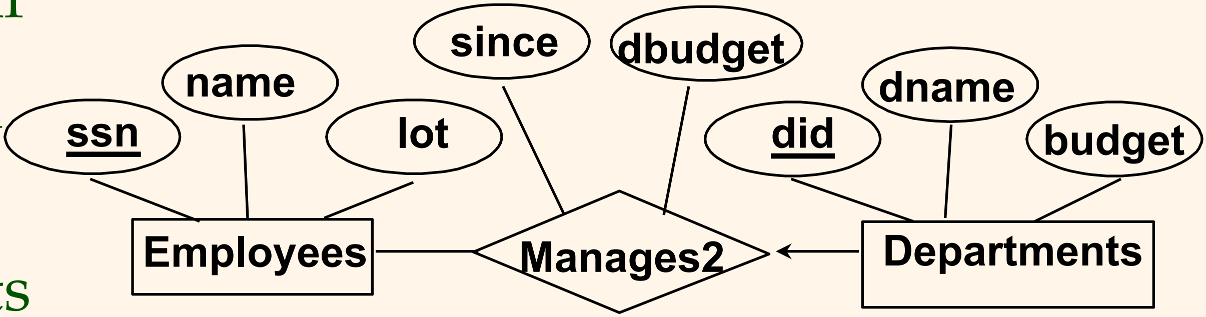


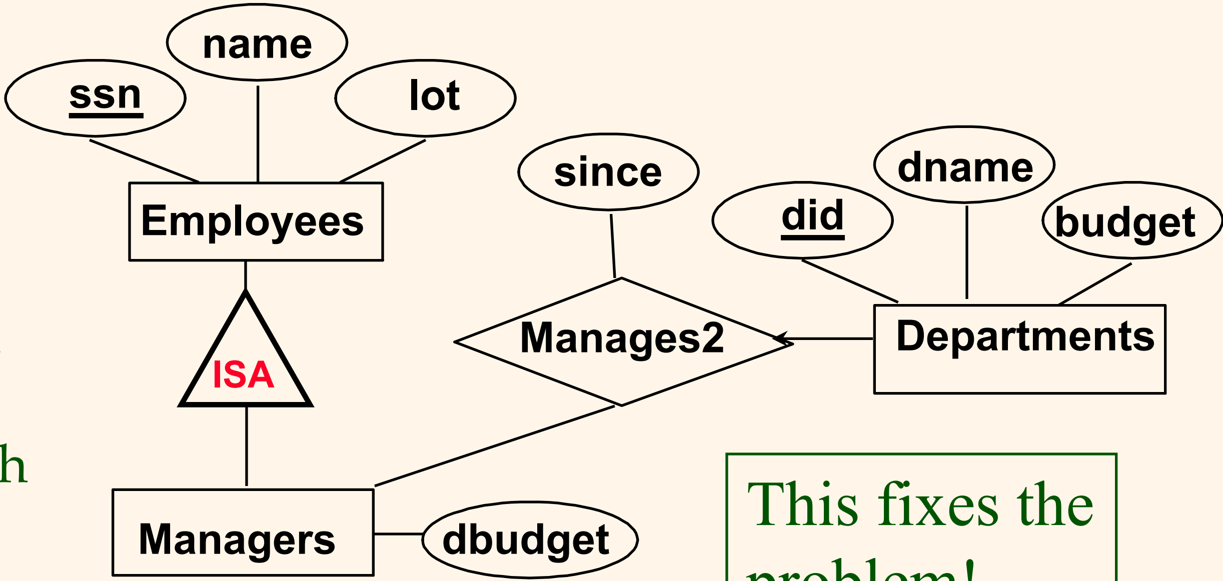
- Similar to the problem of wanting to record several addresses for an employee: We want to record *several values of the descriptive attributes for each instance of this relationship.* Accomplished by introducing new entity set, Duration.



Entity vs. Relationship

- First ER diagram OK if a manager gets a separate discretionary budget for each dept.
- What if a manager gets a discretionary budget that covers *all* managed depts?
  - Redundancy: *dbudget* stored for each dept managed by manager.
  - Misleading: Suggests *dbudget* associated with department-mgr combination.

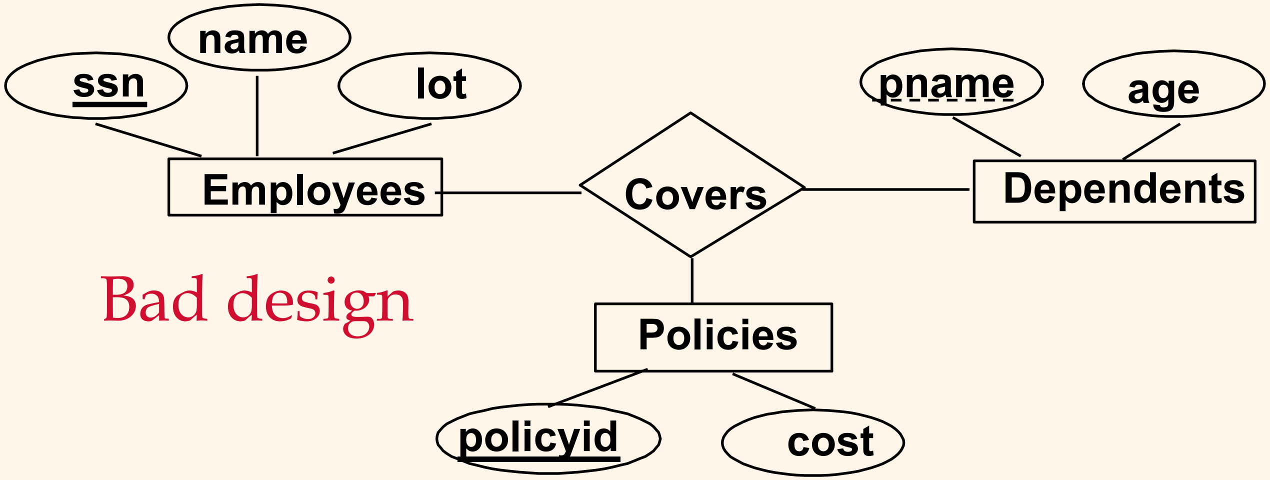




This fixes the problem!

Binary vs. Ternary Relationships

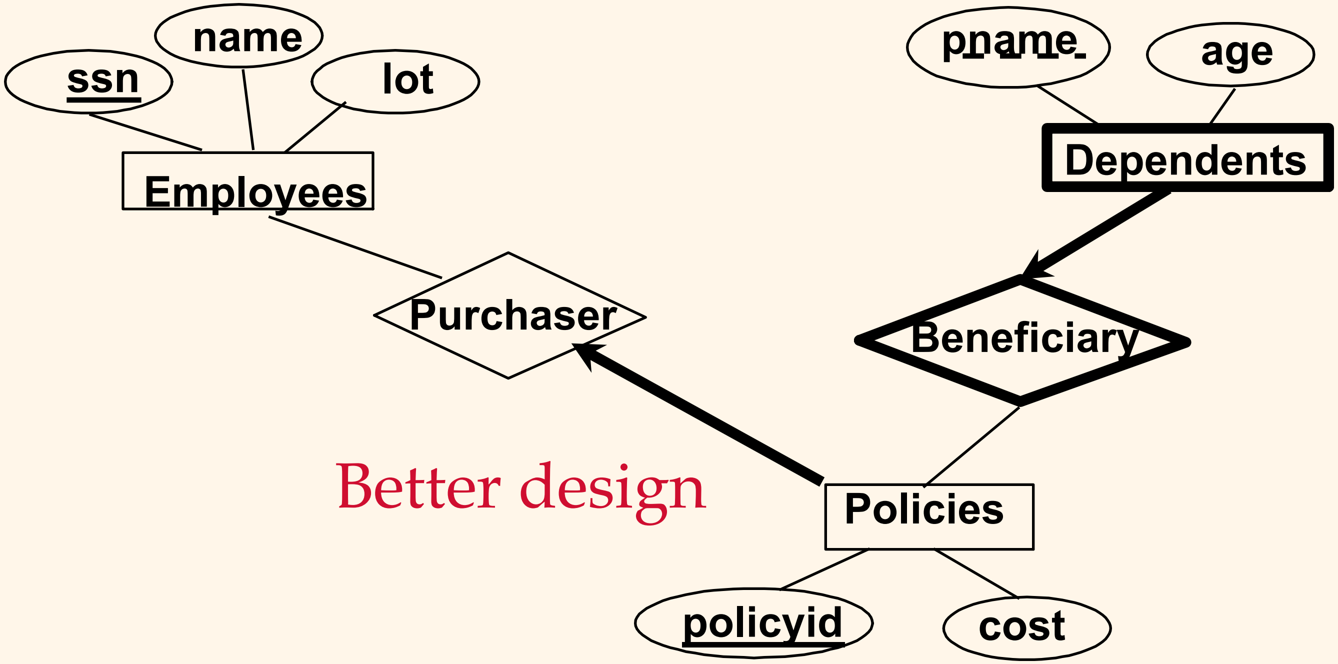
- A policy cannot be owned by two or more employees
- Every policy must be owned by some employee
- Dependents is a weak entity set, and each dependent is identified by *pname* and *policyid*



Bad design

Binary vs. Ternary Relationships

- A policy cannot be owned by two or more employees
- Every policy must be owned by some employee
- Dependents is a weak entity set, and each dependent is identified by *pname* and *policyid*



Better design

Case Study – requirement analysis

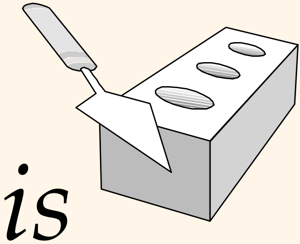
- I would like my customers to browse my catalog of books and place orders over the Internet. Currently, I take orders over the phone. I have mostly corporate customers who call me and give me the ISBN number of a book and a quantity; they often pay by credit card.
- If I don’t have enough copies in stock, I order additional copies and delay shipment until new copies arrive; I want to ship a customer’s order together. My catalog includes all books I sell.
- For each book, the catalog contains ISBN, title, author, purchase price, sales price, and year of publish.
- Most customers are regulars, and I have records with their names and addresses. New customers have to call me first and setup an account before they can use my website.
- On website, customers first identify themselves by customer id, then they are able to browse my catalog and place orders online.

Case Study – requirement analysis

- I would like my customers to browse my catalog of books and place orders over the Internet. Currently, I take orders over the phone. I have mostly corporate customers who call me and give me the ISBN number of a book and a quantity; they often pay by credit card.
- If I don't have enough copies in stock, I order additional copies and delay shipment until new copies arrive; I want to ship a customer's order together. My catalog includes all books I sell.
- For each **book**, the catalog contains ISBN, title, author, purchase price, sales price, and year of publish.
- Most customers are regulars, and I have records with their names and addresses. New customers have to call me first and setup an account before they can use my website.
- On website, customers first identify themselves by customer id, then they are able to browse my catalog and place orders online.

Case Study – requirement analysis

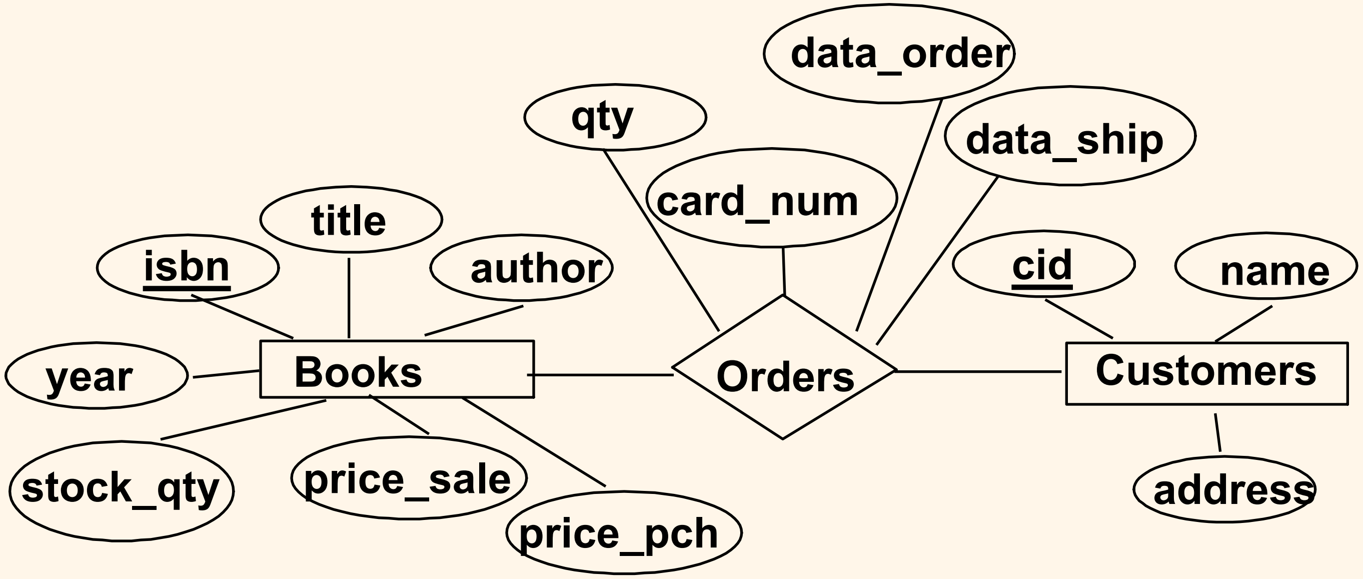
- I would like my customers to browse my catalog of books and place orders over the Internet. Currently, I take orders over the phone. I have mostly corporate customers who call me and give me the ISBN number of a book and a quantity; they often pay by credit card.
- If I don’t have enough copies in stock, I order additional copies and delay shipment until new copies arrive; I want to ship a customer’s order together. My catalog includes all books I sell.
- For each book, the catalog contains ISBN, title, author, purchase price, sales price, and year of publish.
- Most **customers** are regulars, and I have records with their names and addresses. New customers have to call me first and setup an account before they can use my website.
- On website, customers first identify themselves by customer id, then they are able to browse my catalog and place orders online.



Case Study – requirement analysis

- I would like my customers to browse my catalog of books and place orders over the Internet. Currently, I take **orders** over the phone. I have mostly corporate customers who call me and give me the ISBN number of a book and a quantity; they often pay by credit card.
- If I don't have enough copies in stock, I order additional copies and delay shipment until new copies arrive; I want to ship a customer's order together. My catalog includes all books I sell.
- For each book, the catalog contains ISBN, title, author, purchase price, sales price, and year of publish.
- Most customers are regulars, and I have records with their names and addresses. New customers have to call me first and setup an account before they can use my website.
- On website, customers first identify themselves by customer id, then they are able to browse my catalog and place orders online.

Case Study – conceptual design



- What if a customer places two orders for the same book in one day?
- What if a customer places two orders of different books in one day?
- What if a customer places two orders of same book on different days?

Summary of Conceptual Design

- *Conceptual design* follows *requirements analysis,*
  - Yields a high-level description of data to be stored
- ER model popular for conceptual design
  - Constructs are expressive, close to the way people think about their applications.
- Basic constructs: *entities*, *relationships*, and *attributes* (of entities and relationships).
- Some additional constructs: *weak entities*, *ISA hierarchies*, and *aggregation*.
- Note: There are many variations on ER model.

Summary of ER (Contd.)

- Several kinds of integrity constraints can be expressed in the ER model: *key constraints*, *participation constraints*, and *overlap/covering constraints* for ISA hierarchies. Some *foreign key constraints* are also implicit in the definition of a relationship set.
  - Some constraints (notably, *functional dependencies*) cannot be expressed in the ER model.
  - Constraints play an important role in determining the best database design for an enterprise.

Summary of ER (Contd.)

- ER design is *subjective*. There are often many ways to model a given scenario! Analyzing alternatives can be tricky, especially for a large enterprise. Common choices include:
  - Entity vs. attribute, entity vs. relationship, binary or n-ary relationship, whether or not to use ISA hierarchies, and whether or not to use aggregation.
- Ensuring good database design: resulting relational schema should be analyzed and refined further. FD information and normalization techniques are especially useful.