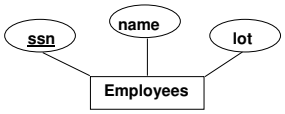
The Entity-Relationship Model

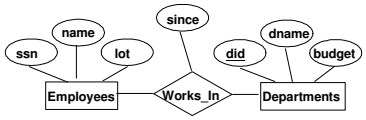
Entities



ER Model Basics

- *Entity:* Real-world object distinguishable from other objects. An entity is described (in DB) using a set of *attributes*
- *Entity Set*: A collection of similar entities. E.g., all employees
  - All entities in an entity set have the same set of attributes
  - Each entity set has a *key*
  - Each attribute has a *domain*

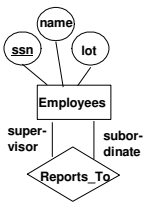
Relationships



ER Model Basics (Contd.)

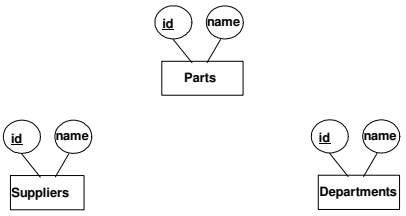
- *Relationship*: Association among two or more entities.
  - E.g., Attishoo works in Pharmacy department.
- *Relationship Set*: Collection of similar relationships.
  - An n-ary relationship set R relates n entity sets E1 ... En
  - Each relationship in R involves entities e1 in E1, ..., en in En

Relationships (Contd.)



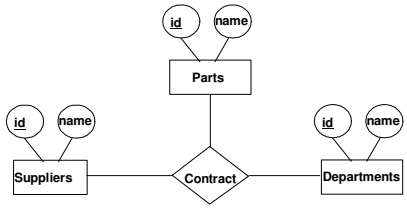
- Want to capture supervisor-subordinate relationship

Relationships (Contd.)

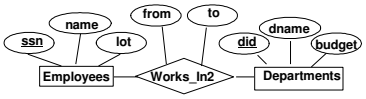


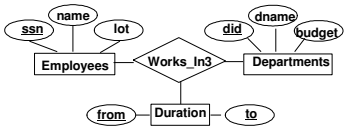
- Want to capture information that a Supplier s supplies Part p to Department d

Ternary Relationship



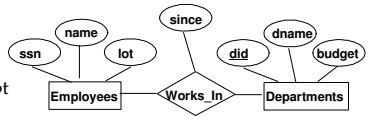
How are these different?



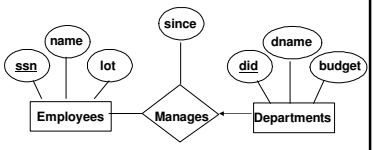


Key Constraints

- An employee can work in many departments; a dept can have many employees

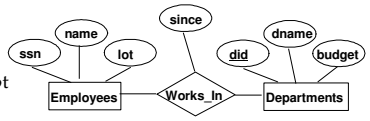


- Each dept has at most one manager, according to the *key constraint* on Manages.

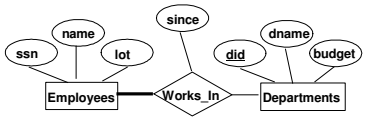


Participation Constraints

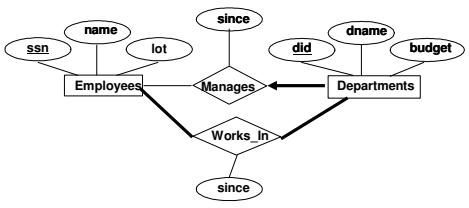
- An employee can work in many departments; a dept can have many employees



- Each employee works in at least one department according to the *participation constraint* on Works_In

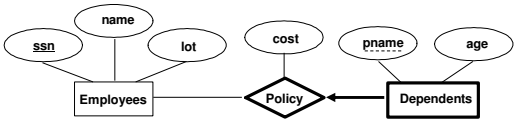


What does this mean?

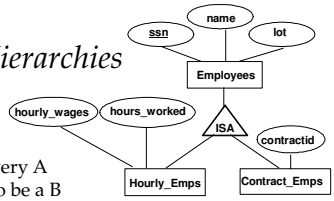


Weak Entities

- 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 (one owner, many weak entities).
  - Weak entity set must have total participation in this *identifying* relationship set.



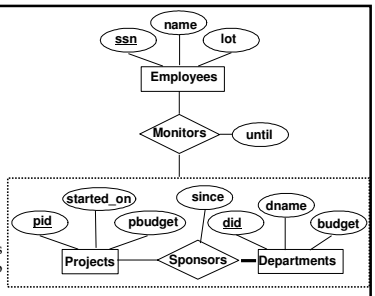
ISA (`is a') Hierarchies



- As in C++, or other PLs, attributes are inherited.
- If we declare A **ISA** B, 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)*
- Reasons for using ISA:
  - To add descriptive attributes specific to a subclass.
  - To identify entitities that participate in a relationship.

Aggregation

- Used when we have to model a relationship involving (entitity 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.

Summary of Conceptual Design

- *Conceptual design* follows *requirements analysis*
- ER model popular for conceptual design
- Basic constructs: *entities*, *relationships*, and *attributes*
- Some additional constructs: *weak entities*, *ISA hierarchies*, and *aggregation*.
- Note: There are many variations on ER model.