Information Policy

Database

C03. Entity Relationship Model

- Code: 164323-03
- Course: Information Policy
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- Professor: Sync Sangwon Lee, Ph. D

Contents

01. Overview of Database Design

- Conceptual design: (ER Model is used at this stage.)
  - What are the entities and relationships in the enterprise?
  - What information about these entities and relationships should we store in the database?
  - What are the integrity constraints or business rules that hold?
  - A database 'schema' in the ER Model can be represented pictorially (ER diagrams).
  - Can map an ER diagram into a relational schema.

02. ER Model Basics

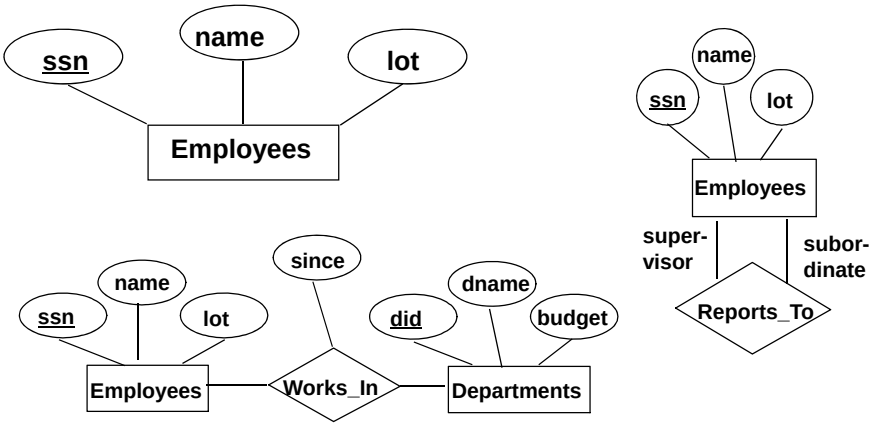
- Entity:
  - Real-world object distinguishable from other objects.
  - An entity is described (in DB) using a set of attributes.
- Entity Set:
  - A collection of similar entities. E.g., all employees.
  - All entities in an entity set have the same set of attributes.
  - (Until we consider ISA hierarchies,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

02. ER Model Basics

- 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 E1, ..., en En
- Same entity set could participate in different relationship sets, or in different “roles” in same set.

02. ER Model Basics

- Examples of ER Model

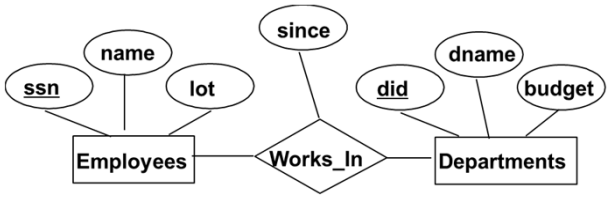


03. Jargon related to ER Model

- Data Model = Data Map + Entity List
- Subject Area: The Target of Modeling
- Entity, Entity Set
- Relationship, Relationship Set
- Identifier = Key
  - Primary Key
  - Foreign Key
  - Alternate Key
  - Candidate Key
- Attribute
  - Basic Attribute
  - Design Attribute
  - Primary Key
  - Derived Attribute
    - ex: sum, number

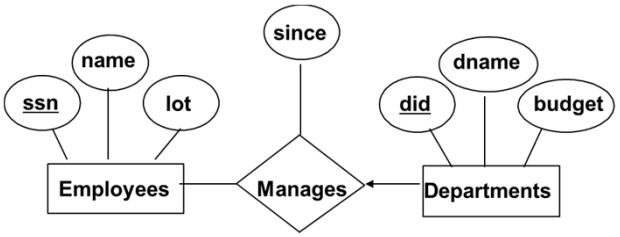
04. Options

- Key Constraint
  - Consider Works_In:
    - An employee can work in many departments;
    - A dept can have many employees.



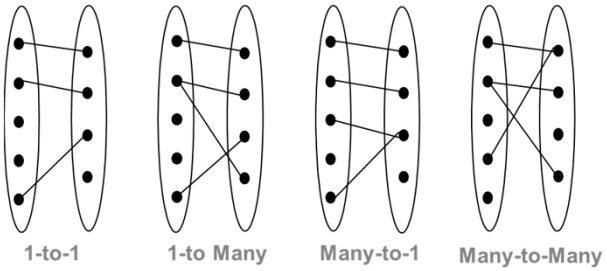
04. Options

- Key Constraint
  - In contrast,
    - each dept has at most one manager, according to the key constraint on Manages.



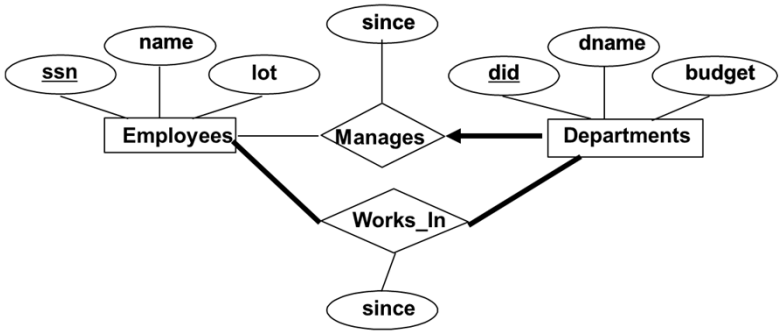
04. Options

- Key Constraint
  - Cardinality



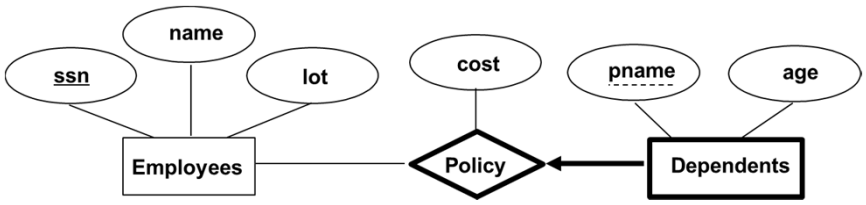
04. Options

- Participate Constraint
  - 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!)



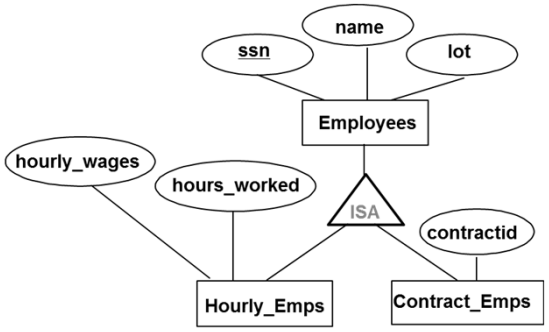
04. Options

- 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.



04. Options

- 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.

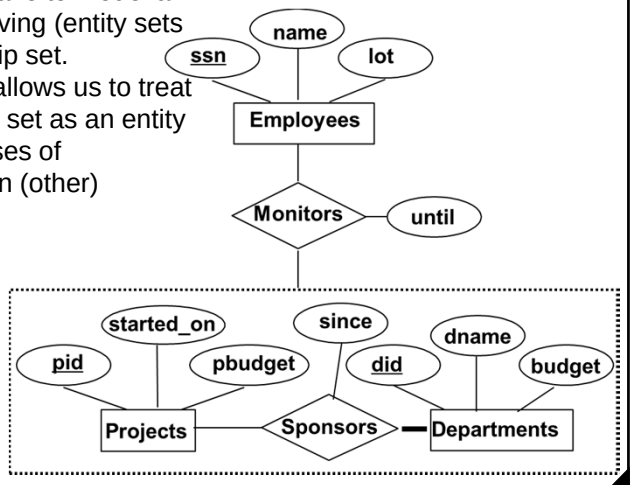


04. Options

- IS-A Hierarchies
  - 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 entities that participate in a relationship.

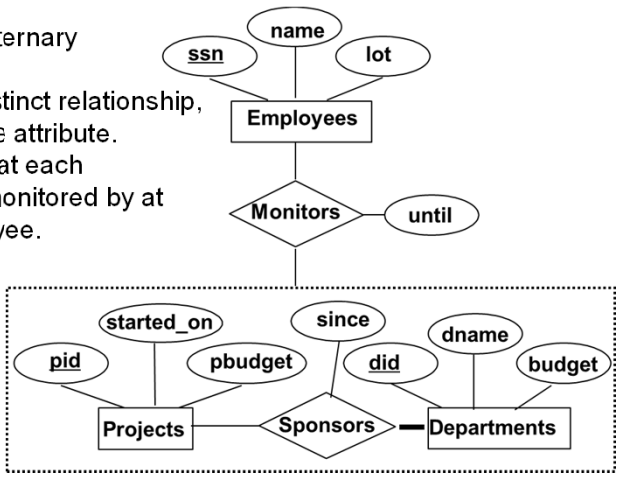
04. Options

- 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.



04. Options

- Aggregation
  - 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.



05. Conceptual Design Using ER Model

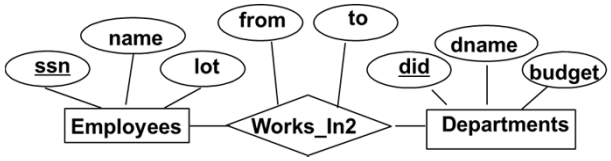
- Conceptual Design Using the ER Model
  - Design choices:
    - Should a concept be modeled as an entity or an attribute?
    - Should a concept be modeled as an entity or a relationship?
    - Identifying relationships: Binary or ternary? Aggregation?
  - Constraints in the ER Model:
    - A lot of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

05. Conceptual Design Using ER Model

- 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).

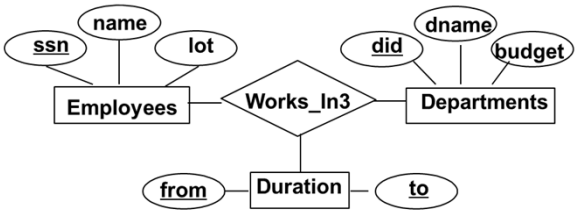
05. Conceptual Design Using ER Model

- Entity vs. Attribute
  - Works_In2 does not allow an employee to work in a department for two or more periods.



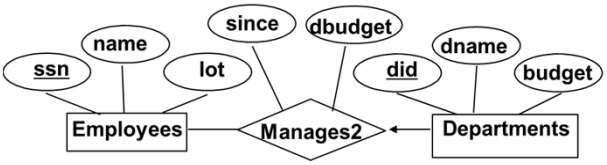
05. Conceptual Design Using ER Model

- Entity vs. Attribute
  - 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.



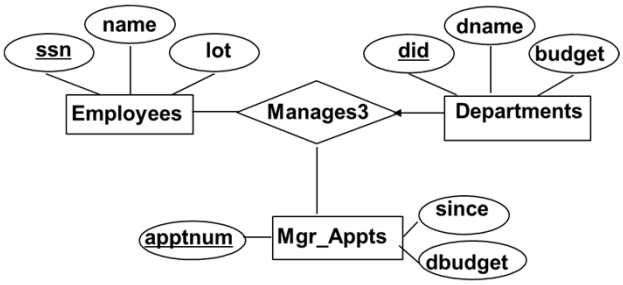
05. Conceptual Design Using ER Model

- Entity vs. Relationship
  - First ER diagram OK if a manager gets a separate discretionary budget for each dept.



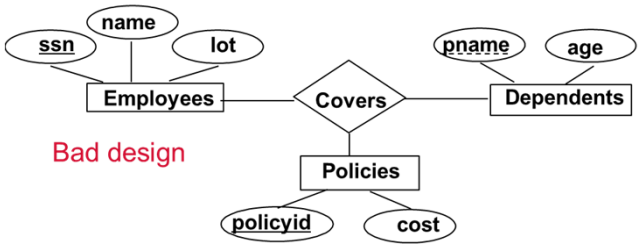
05. Conceptual Design Using ER Model

- Entity vs. Relationship
  - What if a manager gets a discretionary budget that covers all managed depts?
    - Redundancy of dbudget, which is stored for each dept managed by the manager.
    - Misleading: suggests dbudget tied to managed dept.



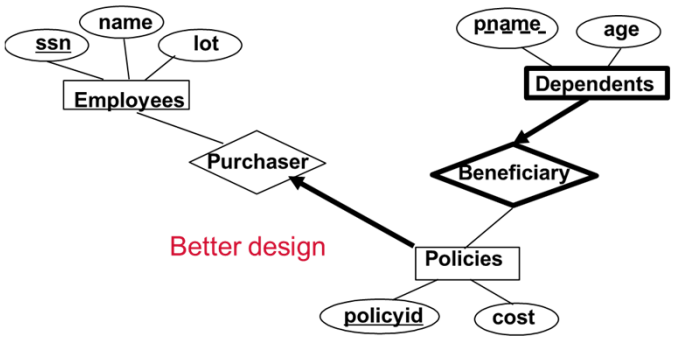
05. Conceptual Design Using ER Model

- Binary vs. Ternary Relationships
  - If each policy is owned by just 1 employee:
    - Key constraint on Policies would mean policy can only cover 1 dependent!



05. Conceptual Design Using ER Model

- Binary vs. Ternary Relationships
  - What are the additional constraints in the 2nd diagram?



05. Conceptual Design Using ER Model

- Binary vs. Ternary Relationships
  - Previous example illustrated a case when two binary relationships were better than one ternary relationship.
  - An example in the other direction: a ternary relation Contracts relates entity sets Parts, Departments and Suppliers, and has descriptive attribute qty. No combination of binary relationships is an adequate substitute:
    - S “can-supply” P, D “needs” P, and D “deals-with” S does not imply that D has agreed to buy P from S.
    - How do we record qty?

06. Tips

- 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.

06. Tips

• 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.

06. Tips

• 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.