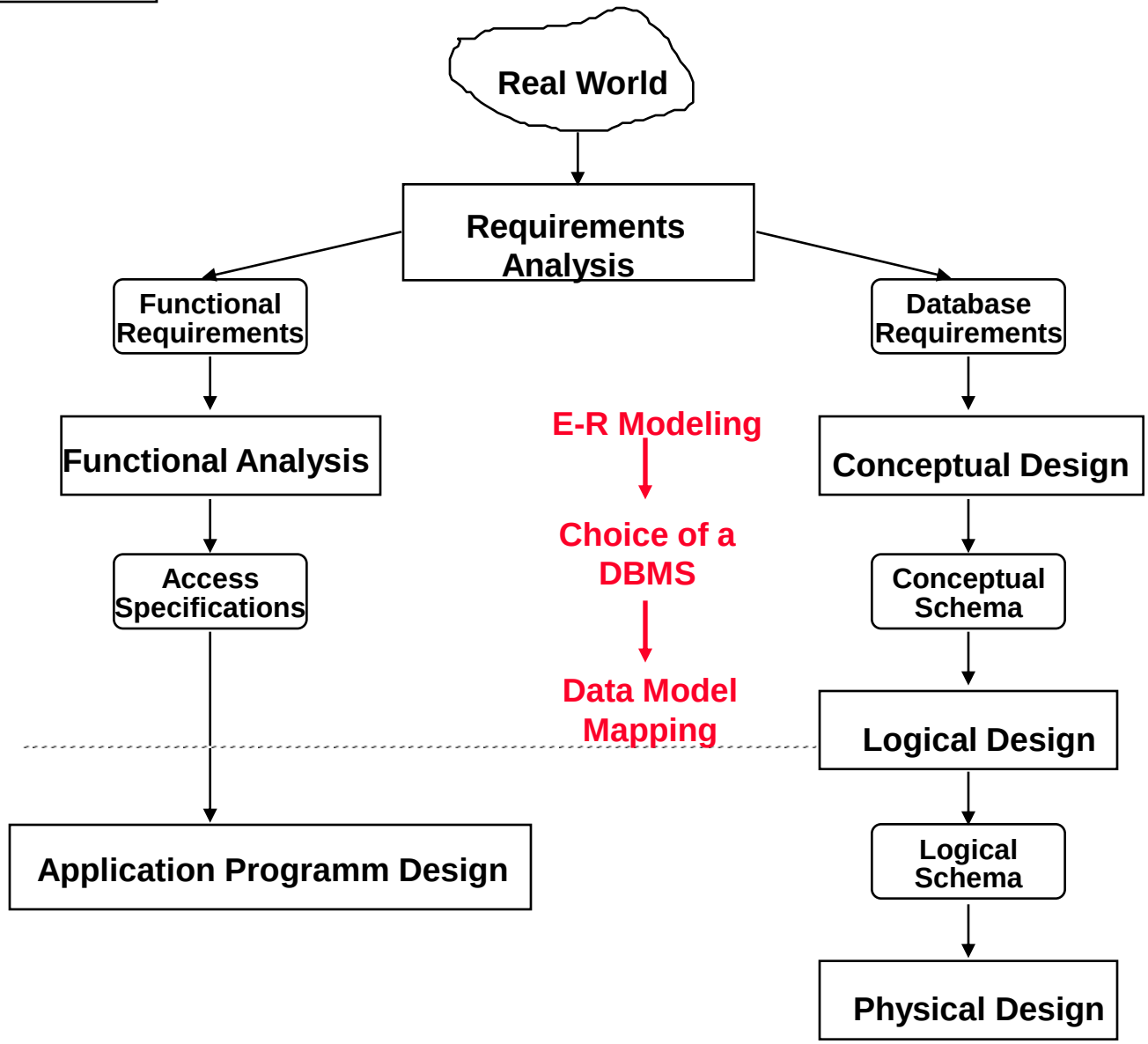
Entity-relationship Data Model

- A logic tool used for database scheme design.
  - Application – ER model – Database scheme.
- Based on a perception that a real world consists of.
  - entities: a set of basic objects, and.
  - relationships among these objects.
- Described by an entity-relationship diagram.

Database Design Process



Entity

- things with independent existence
- described by its attributes
- determined by particular value of its attributes

Example

a customer is an entity with attributes

customer name

social insurance number

address

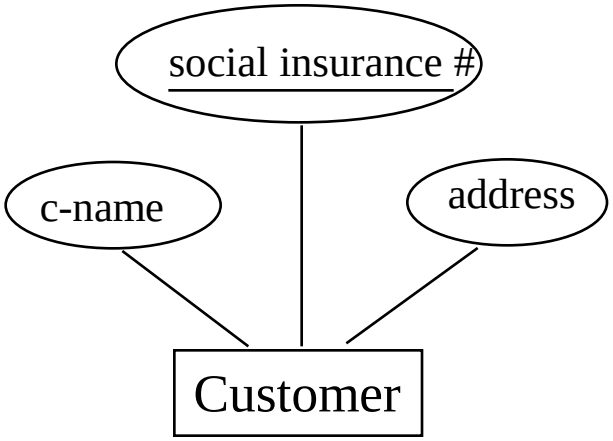
an account is an entity with attributes

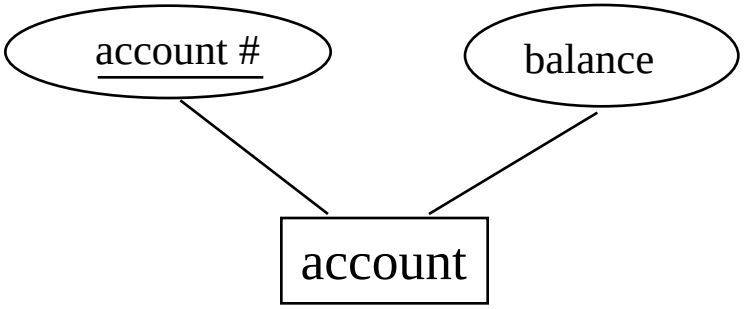
account number

balance

Entity set (entity type)

- Define a set of entities of the same type (share the same structure).
- Denoted by a rectangular box in ER diagram.
- Identified by a list of attributes (in ovals).
- Key attributes.
  - A set of attributes that uniquely identify entity type.



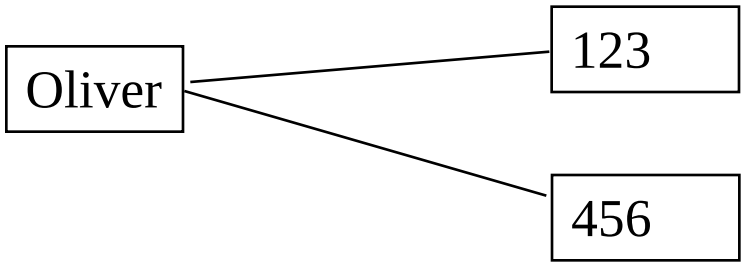


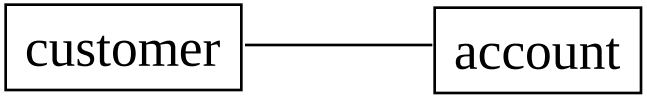
Relationship and Relationship set

- A relationship is an association among several entities.
- A relationship set is a set of relationship of the same type.

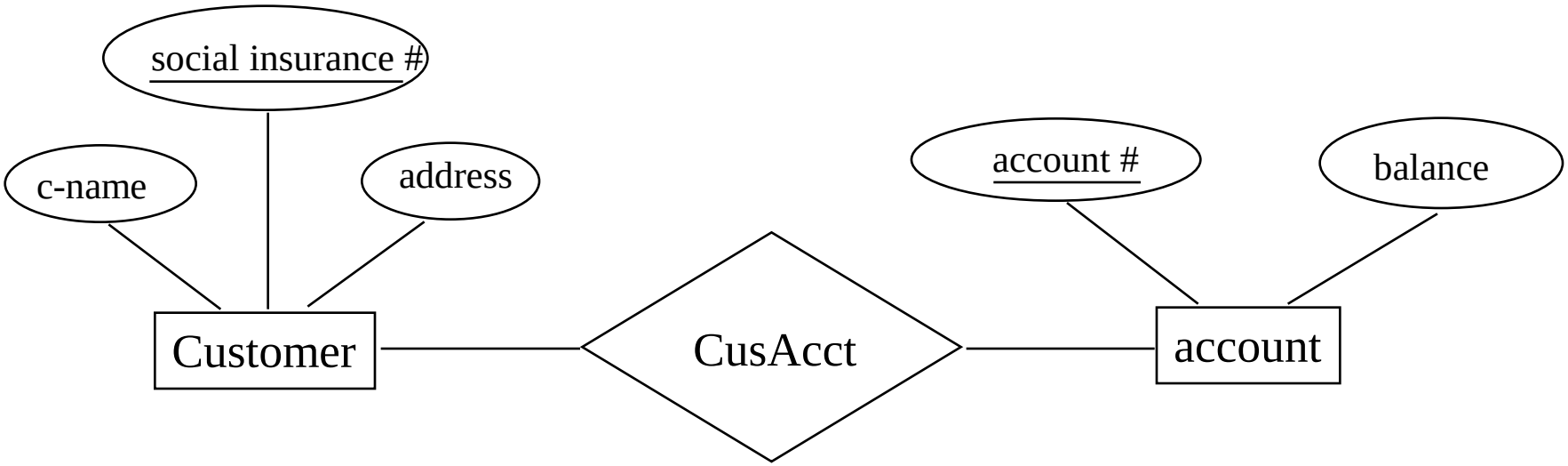
Let E1, E2, ... En be a set of entity sets.
<e1, e2, ..., en> is a relationship, where ei is contained in Ei.
a subset of E1 x E2 x ... x En is a relationship set

Example:

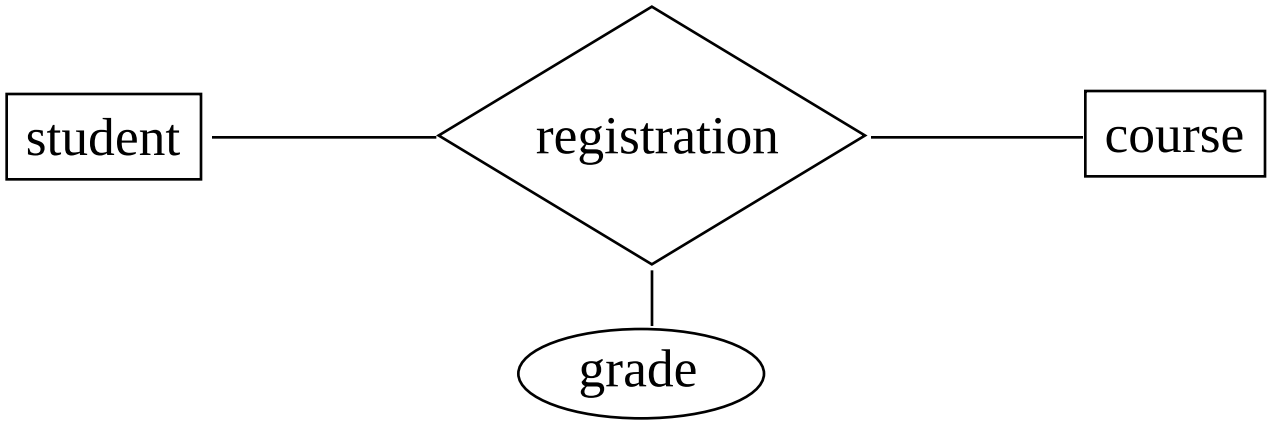




- Relationship sets.
  - Defines an association of entity sets.
  - Is a subset of Cartesian product E1 x E2 x ... x en.
  - Ei is said to play a role in the relationship set.
  - Denoted by a diamond in the ER diagram.

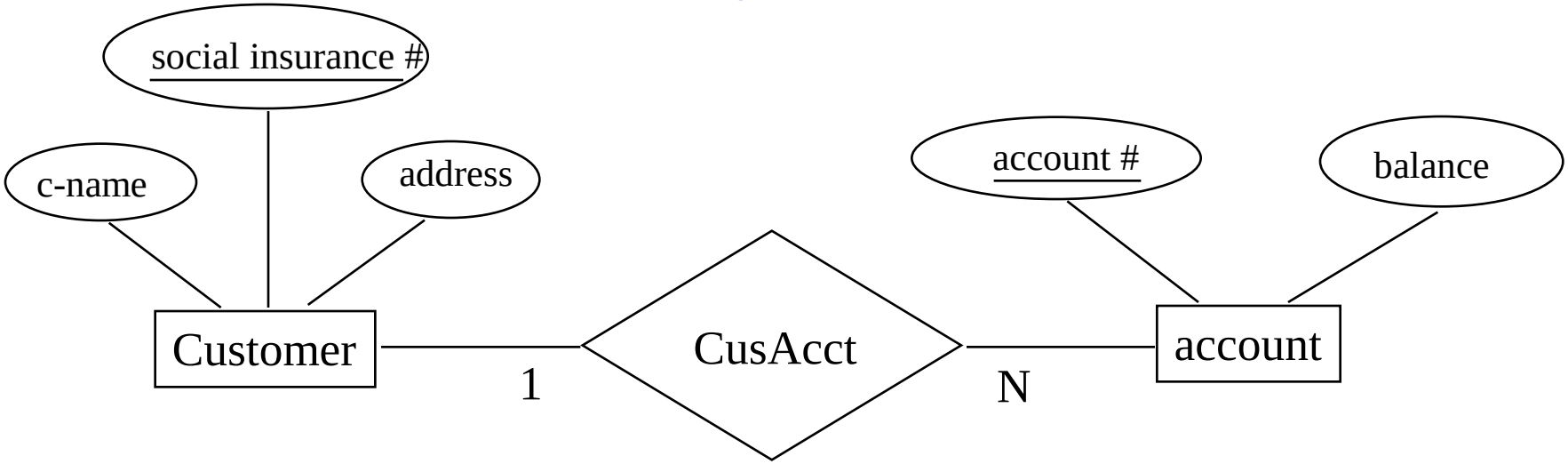


- Descriptive attributes
  - Attributes of relationships



- Structural constraints
  - Degree: the number of participating entity sets
  - Cardinality constraints: 1:1, 1:N, M:N
  - Participation constraints: partial or total

Cardinality Constraints

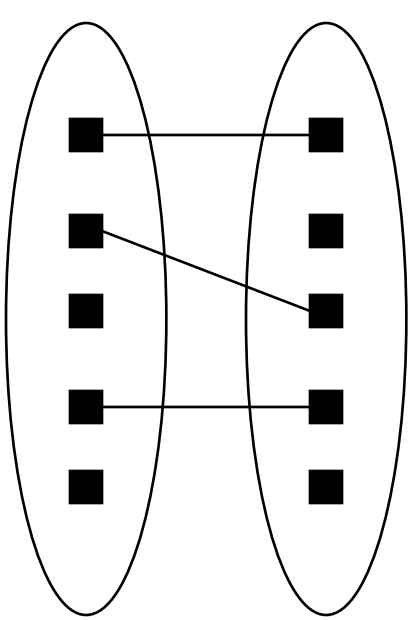


1:1 each customer has at most one account and each account is owned by at most one customer.

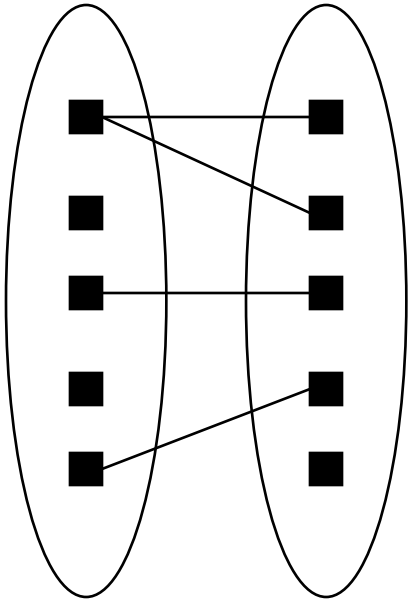
1:N each customer may have any number of accounts but each account is owned by at most one customer.

M:N each customer may have any number of accounts and each account may be owned by any number of customers.

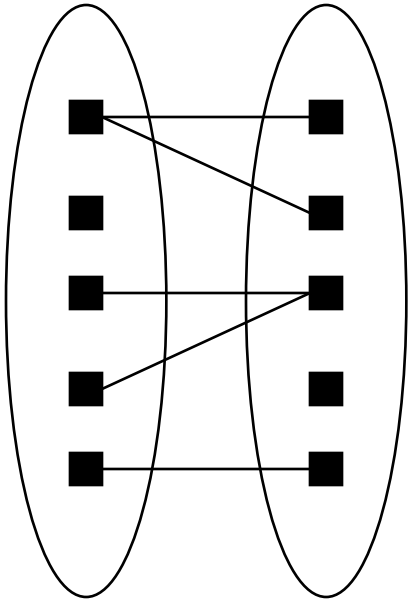
Cardinality Constraints



One-to-One

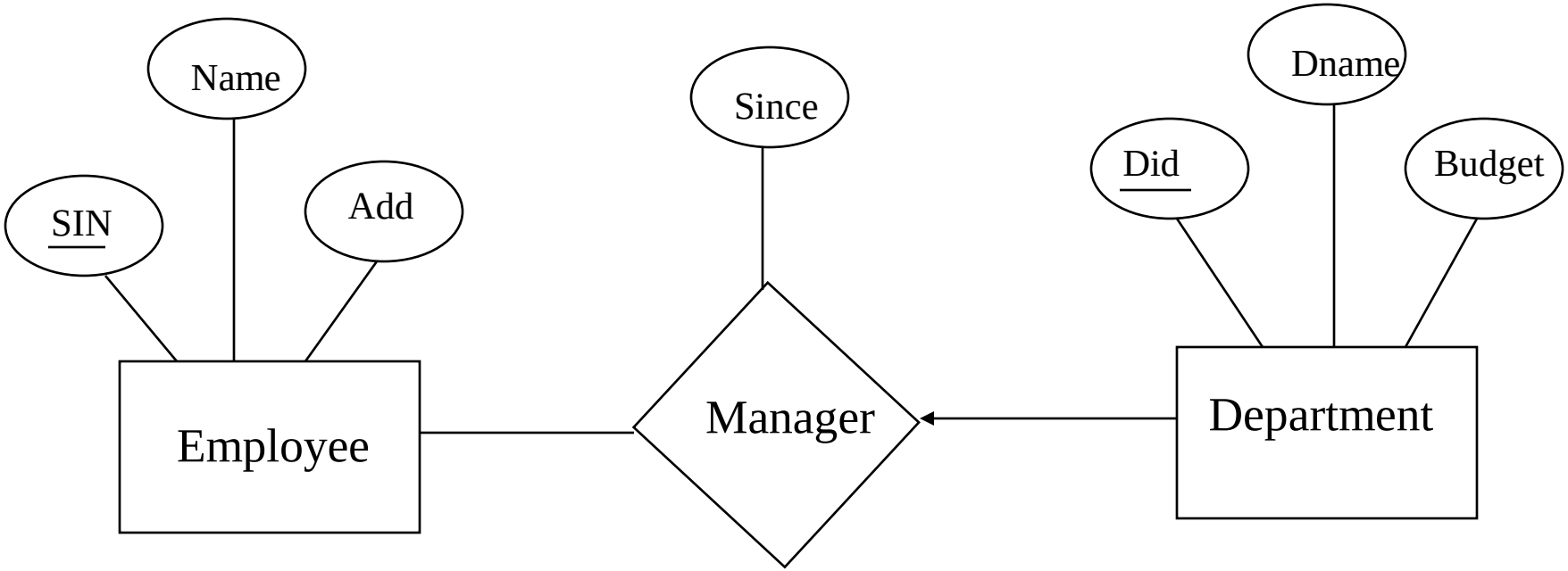


One-to-Many

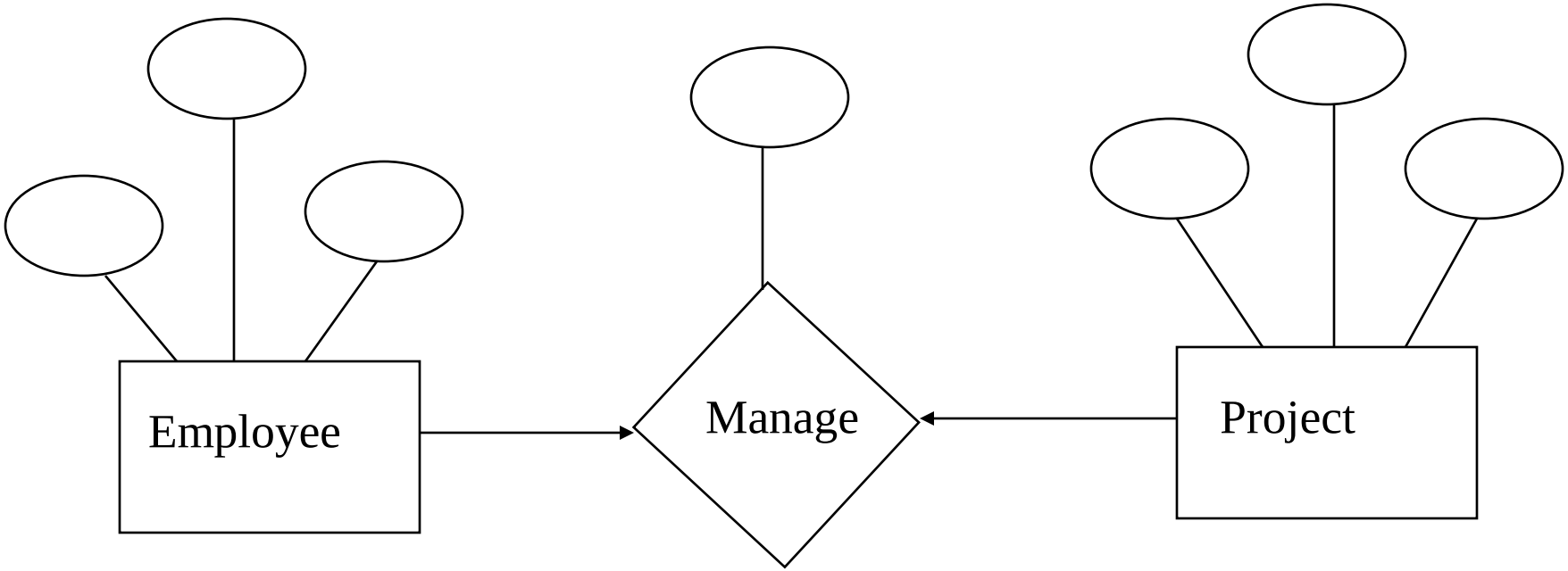


Many-to-Many

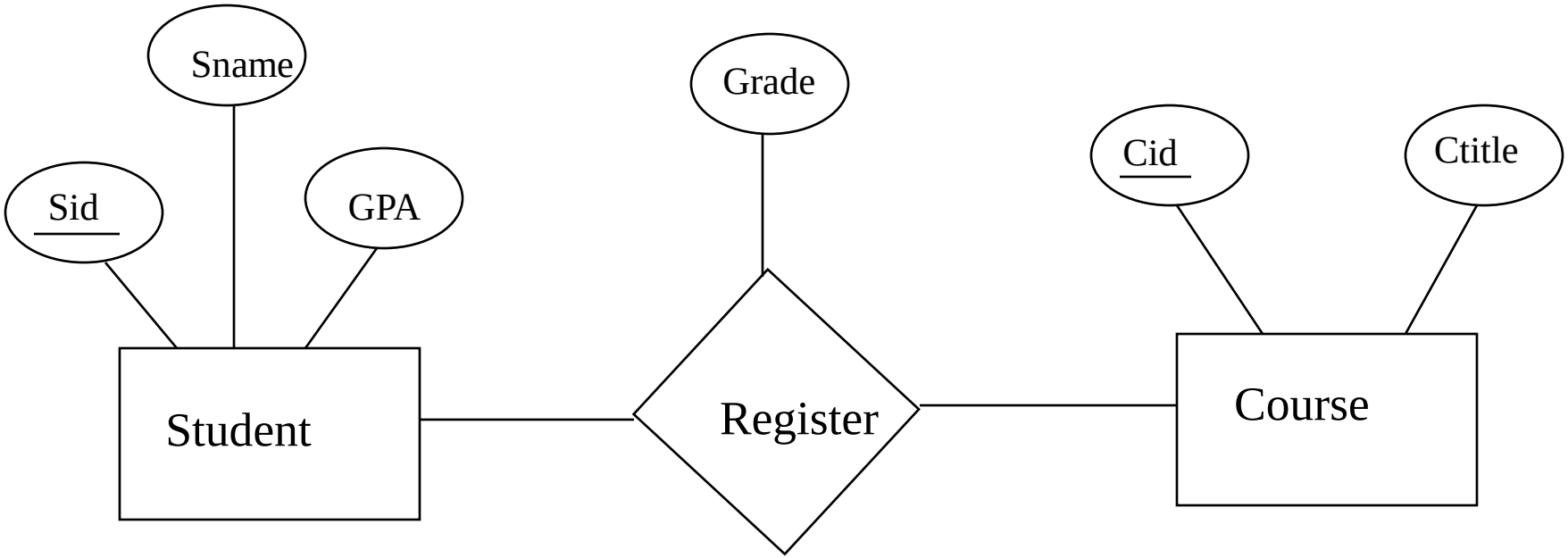
One-to-Many Relationship (Key Constraints)



One-to-One Relationship

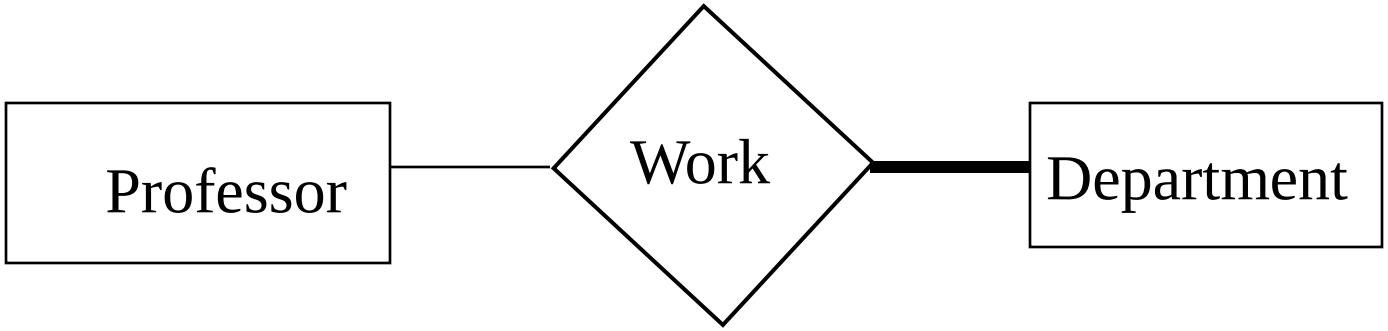


Many-to-Many Relationship



Participation Constraints

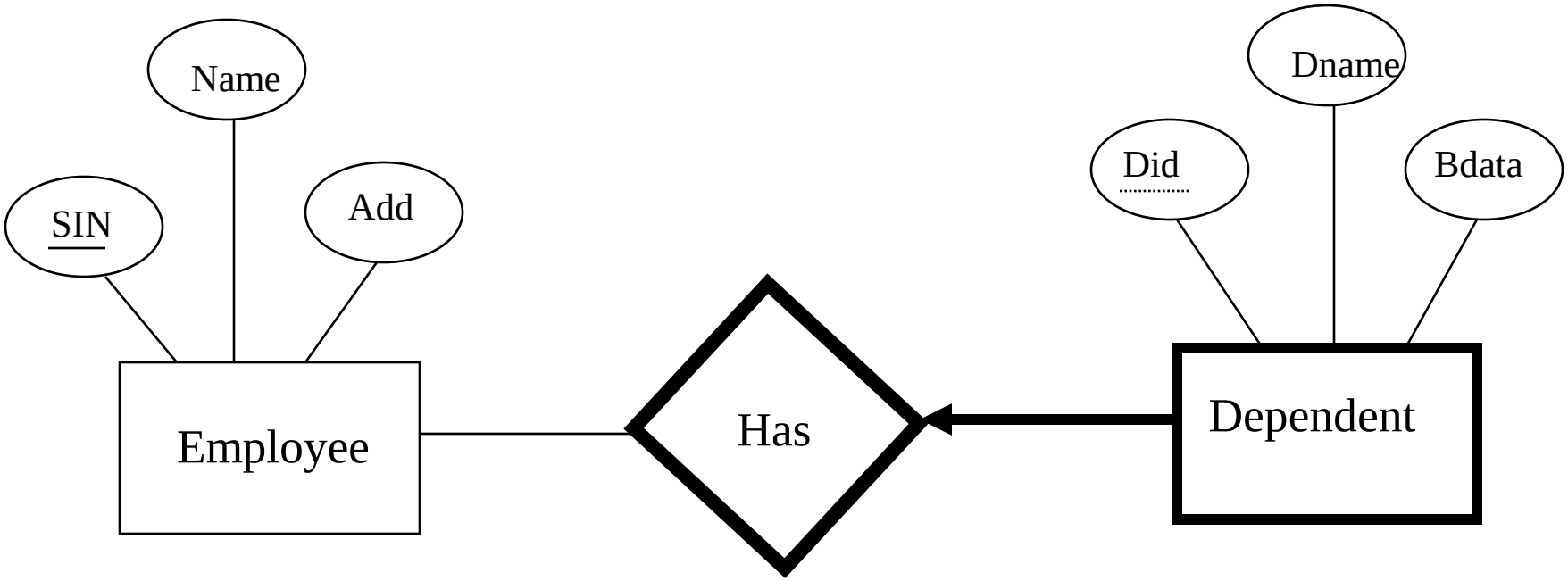
- Given an entity set E and a relationship set R, a participation constraints specifies that for every entity e in E, whether there exists a relationship r in R such that e participates in r.
  - Partial: a professor does not have to work for a department
  - Total: a department must have at least one professor



Weak Entities

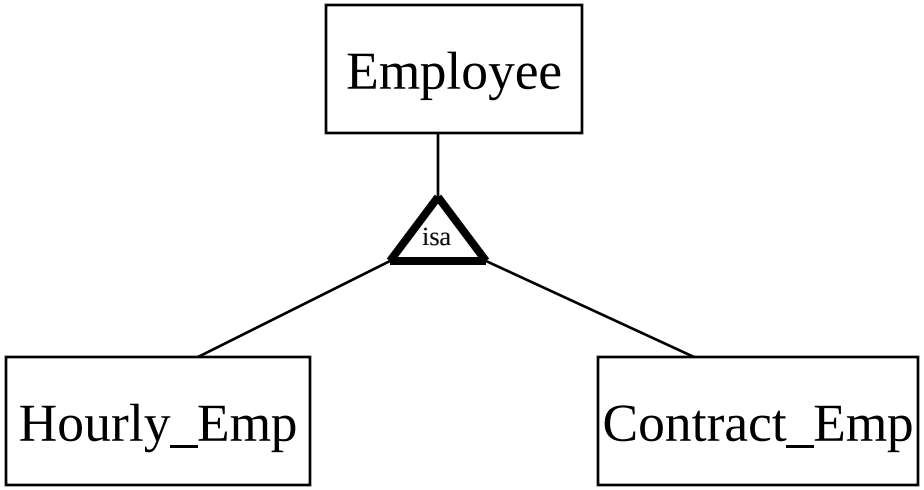
- A weak entity can be identified uniquely only by considering the primary key of another (owner) entity
  - Owner entity set and weak entity set must participate in a one-to-many relationship set (one owner, many weak entities)
  - Weak entity set must have total participation in this identifying relationship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

Weak Entity



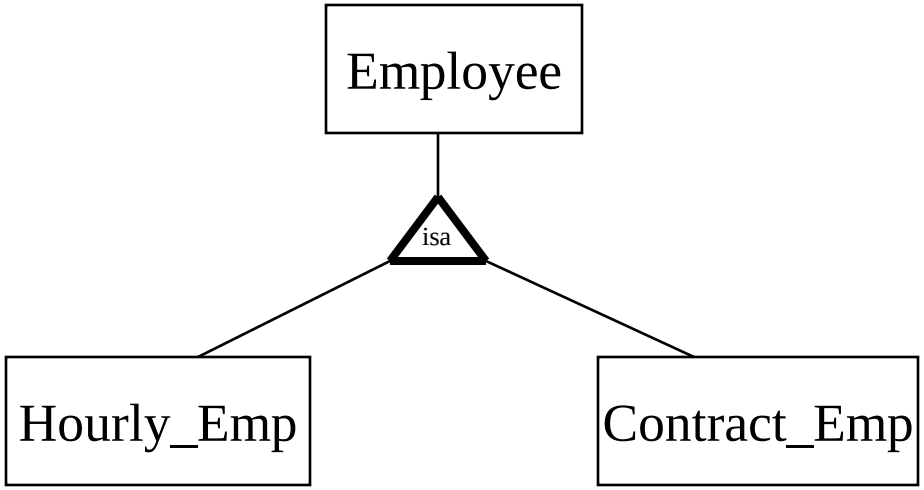
ISA Hierarchies

- If we declare A ISA B, every A entity is also considered to be a B entity
  - Attributes are inherited
  - To add descriptive attribute specific to a subentity
  - To identify entities that participate in a relationship



ISA Hierarchies

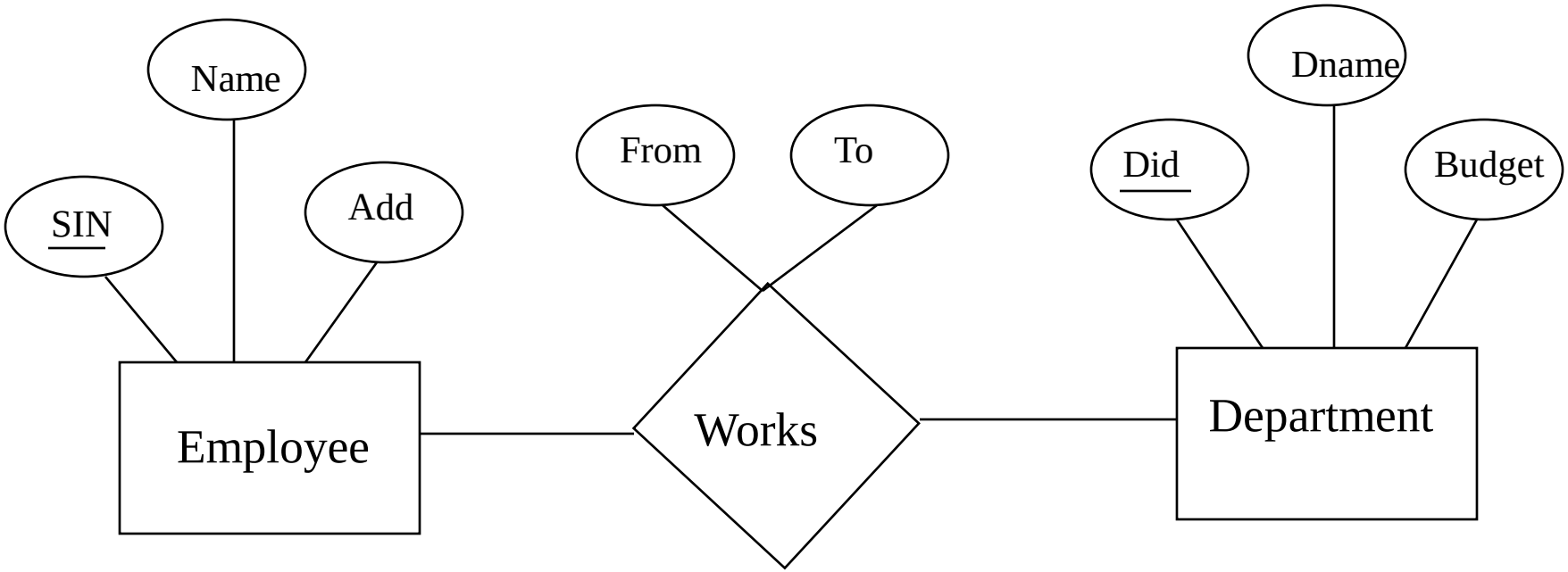
- Constraints
  - Overlap constraints: Can Sarah be an Hourly_Emp as well as a Contract_Emp? (Allowed/disallowed)
  - Covering constraint: Does every Employee have to be an Hourly_Emp or a Constract_Emp? (Yes/no)



Design Choices

- Descriptive attributes versus a new logic entity set
  - Some simple facts may be represented by a few descriptive attributes
  - A new entity maybe needed for more complicated ones
- Entity set versus Relationship set
- Binary versus Ternary Relationships

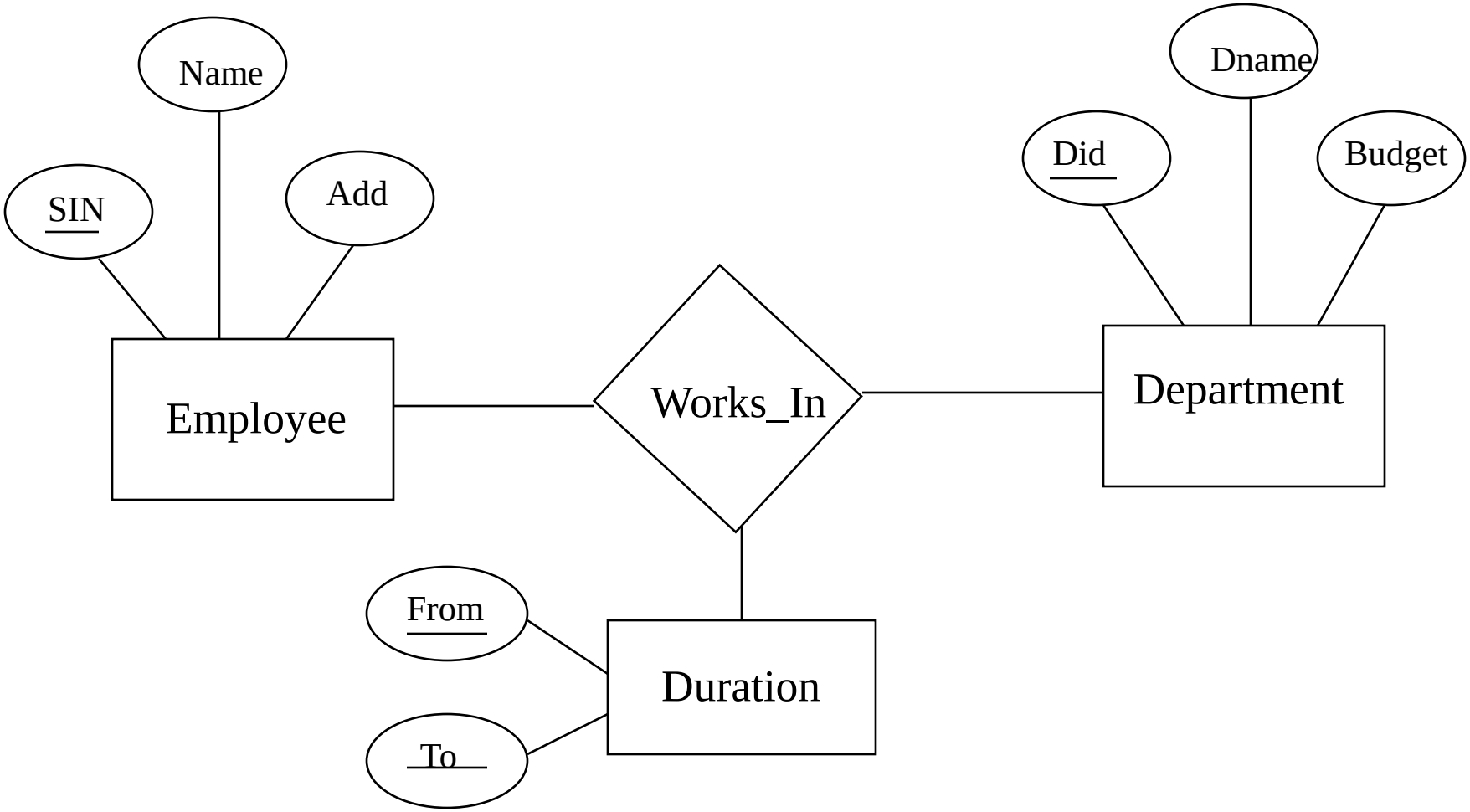
Descriptive attributes versus a new entity set



What if an employee works for a department over more than one period?

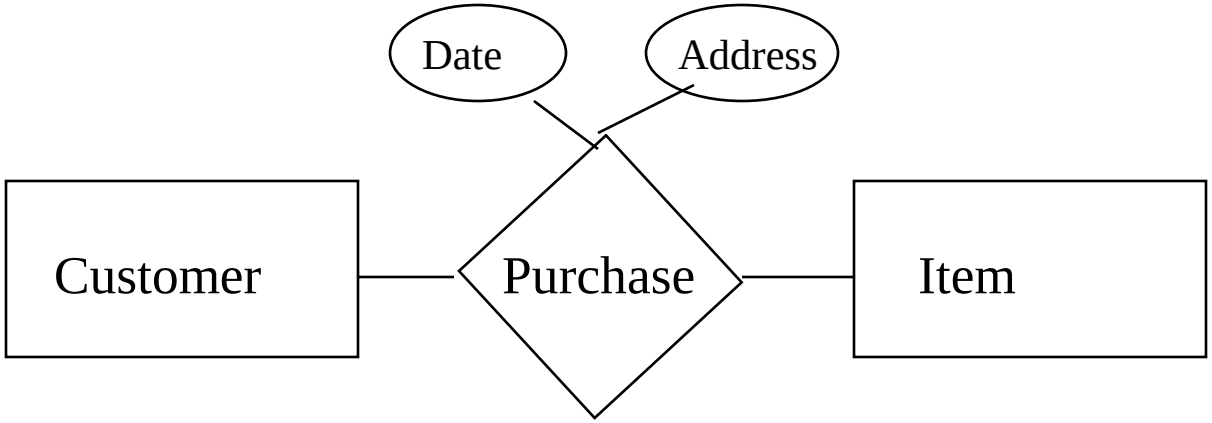
Multiple durations require a new entity set.

Descriptive attributes versus a new entity set



Entity versus Relationship

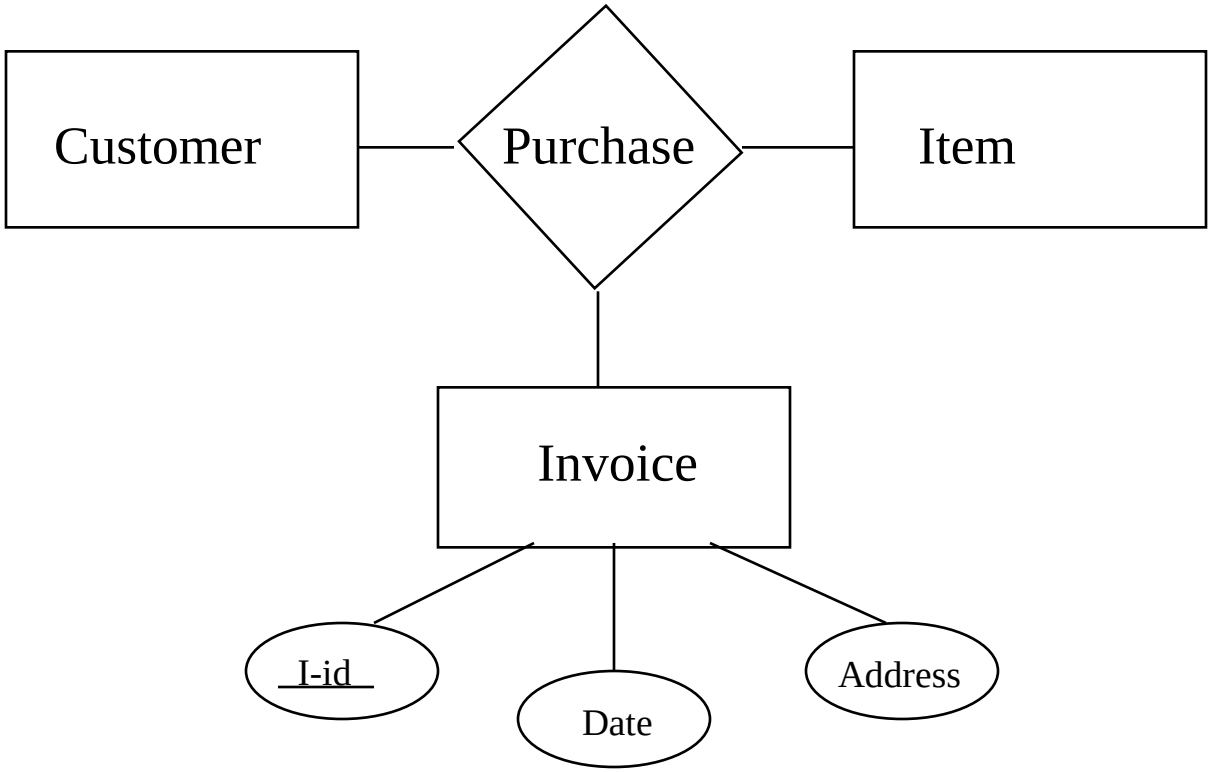
The following describes a simple On-Line database system.



What if a customer may purchase the same set of items again?

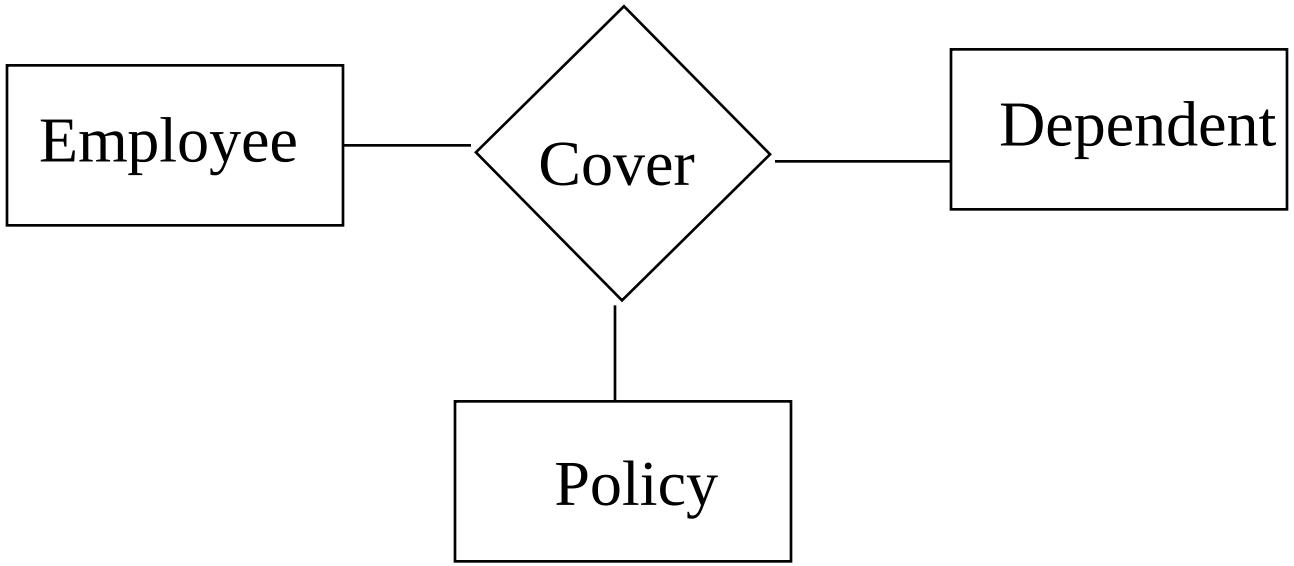
Entity versus Relationship

The following describes a simple On-Line database system.

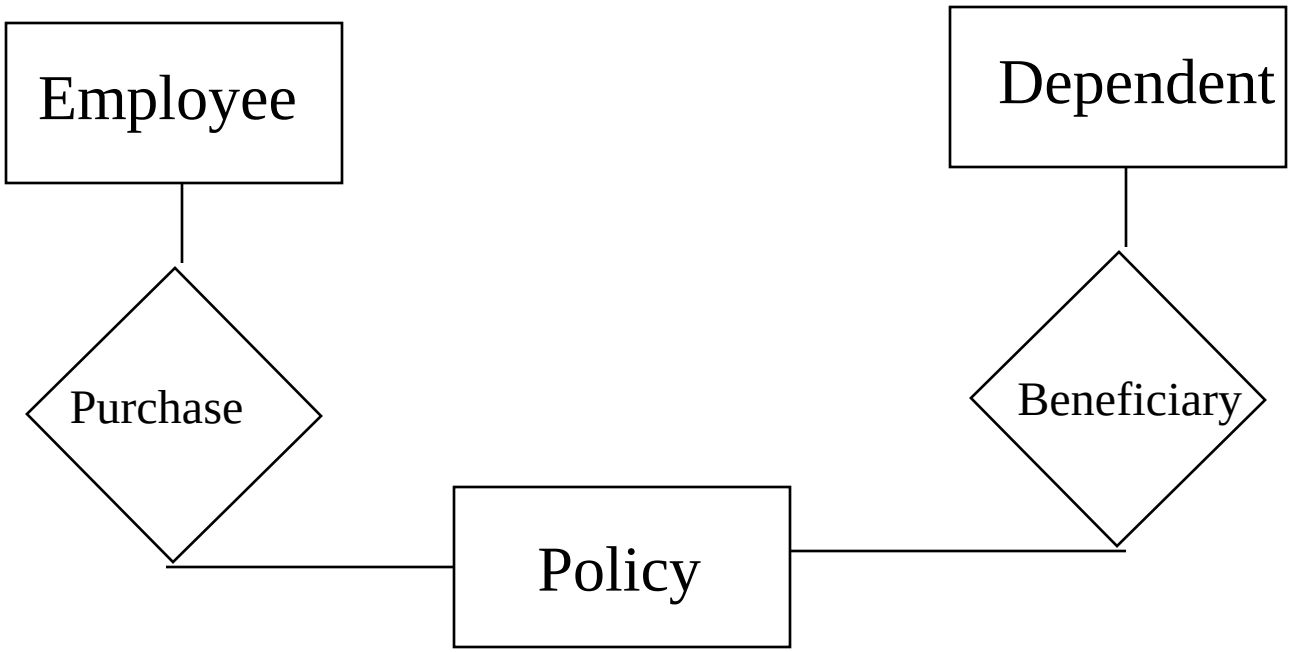


Binary versus Ternary (1)

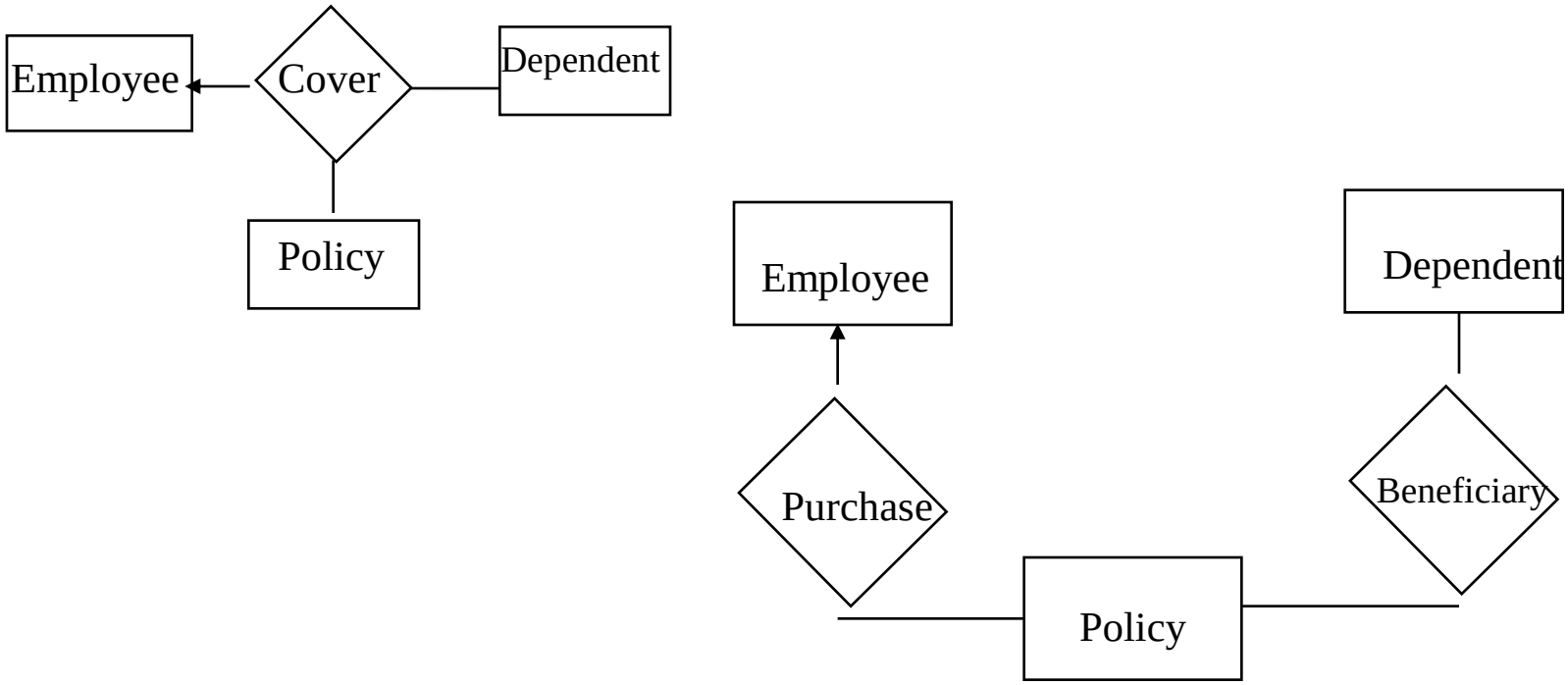
Consider the following two E-R models:



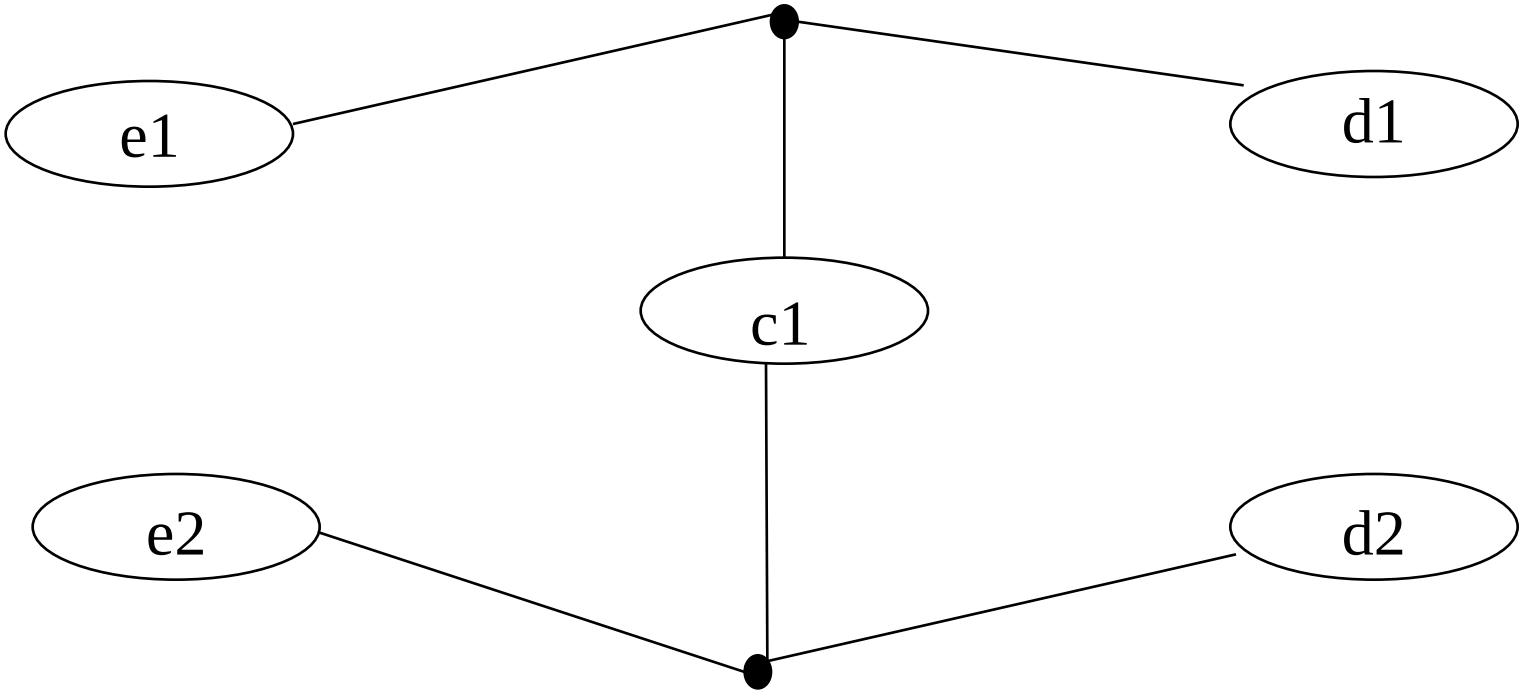
Binary versus Ternary (1)



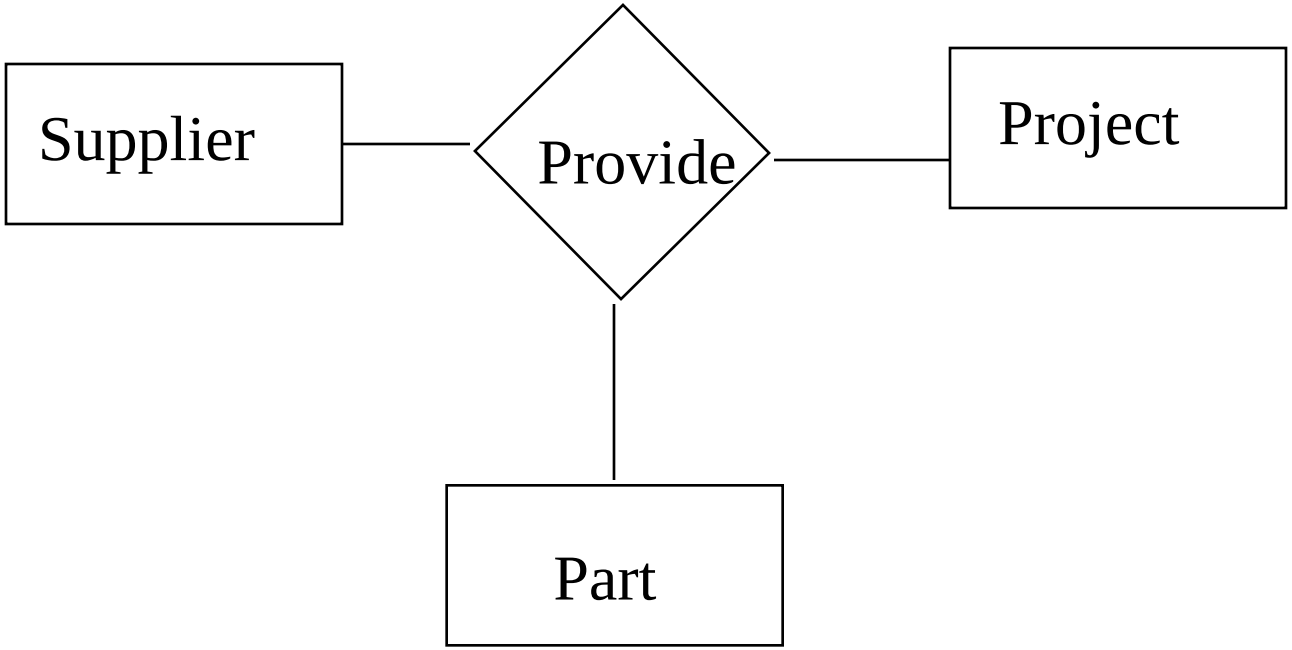
- Questions
  - Are these two E-R models the same?
  - What if no joined policy is allowed?



Consider the following scenario

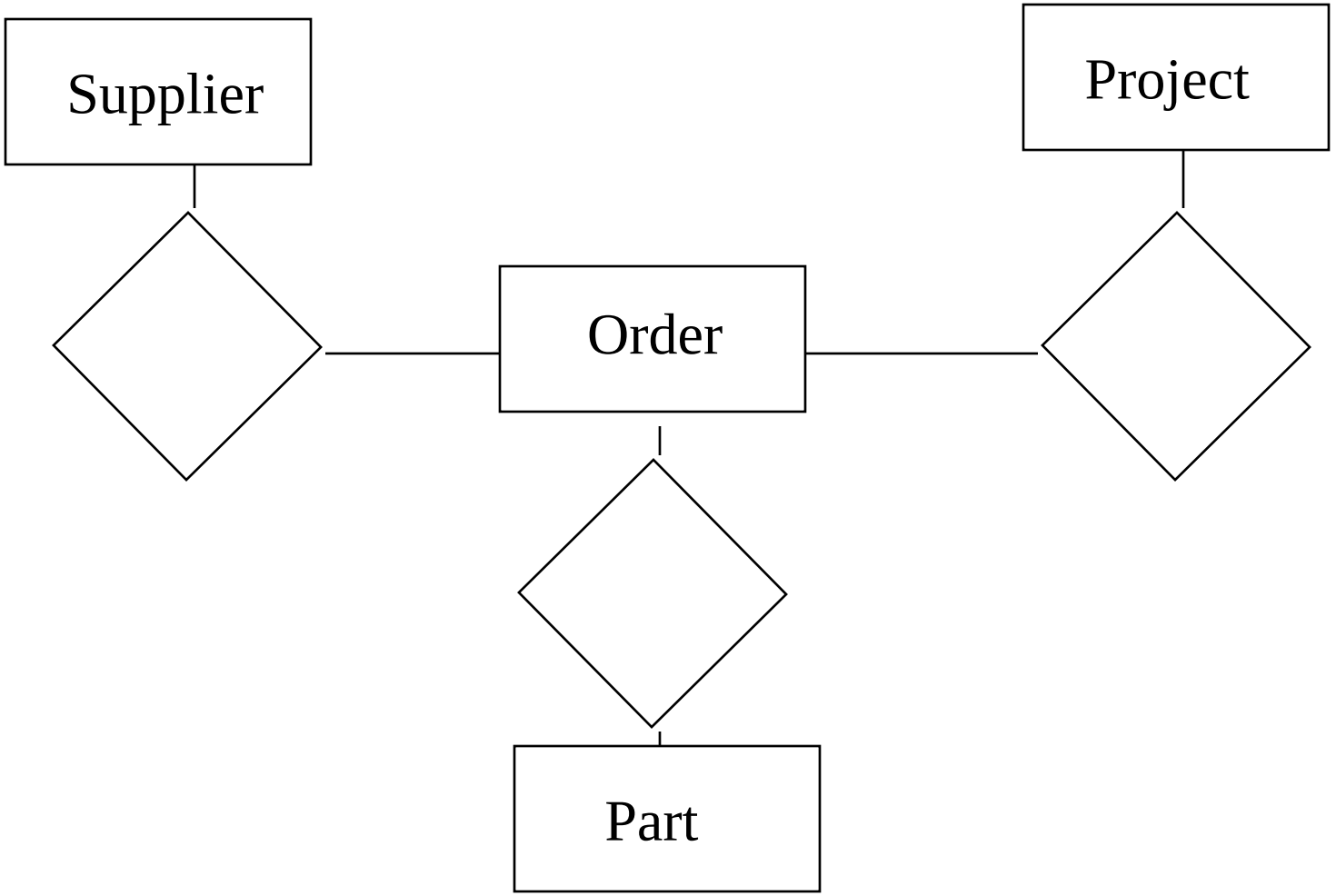


Binary versus Ternary (2)



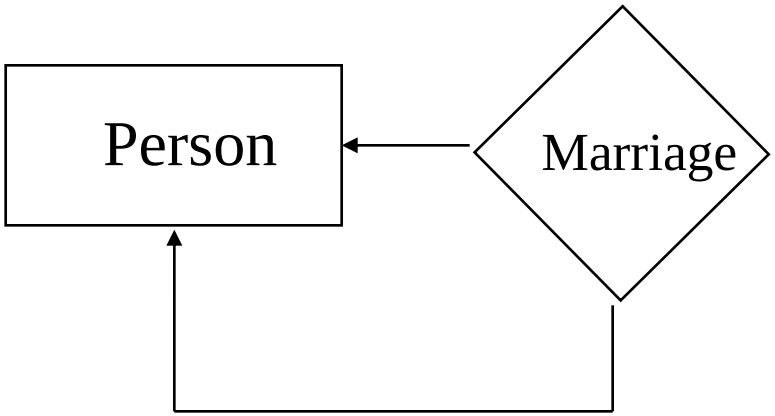
Any problems with this representation?

Binary versus Ternary (2)



Self Relationship

How to represent a marriage relationship?



Represents ER model using tables

- Basic rules:
  - One table for one entity set
    - → One column for one attribute
  - One table for one relationship set
    - → Columns are:
      - ☞ Key attributes of all participating entity sets
      - ☞ All descriptive attributes
- Exceptions
  - 1:N relationships can be omitted

Represents ER model using tables

- Basic rules:
  - One table for one entity set
    - → One column for one attribute
    - → Primary Key consists of the key attributes
  - One table for one relationship set
    - → Columns are:
      - ☞ Key attributes of all participating entity sets
      - ☞ All descriptive attributes
    - → **Foreign keys reference to the key attributes of all the participating entity sets**
- Exceptions
  - 1:N binary relationships can be omitted by **adding the key attributes of one side into the table for the many side**