

ER Design (1)



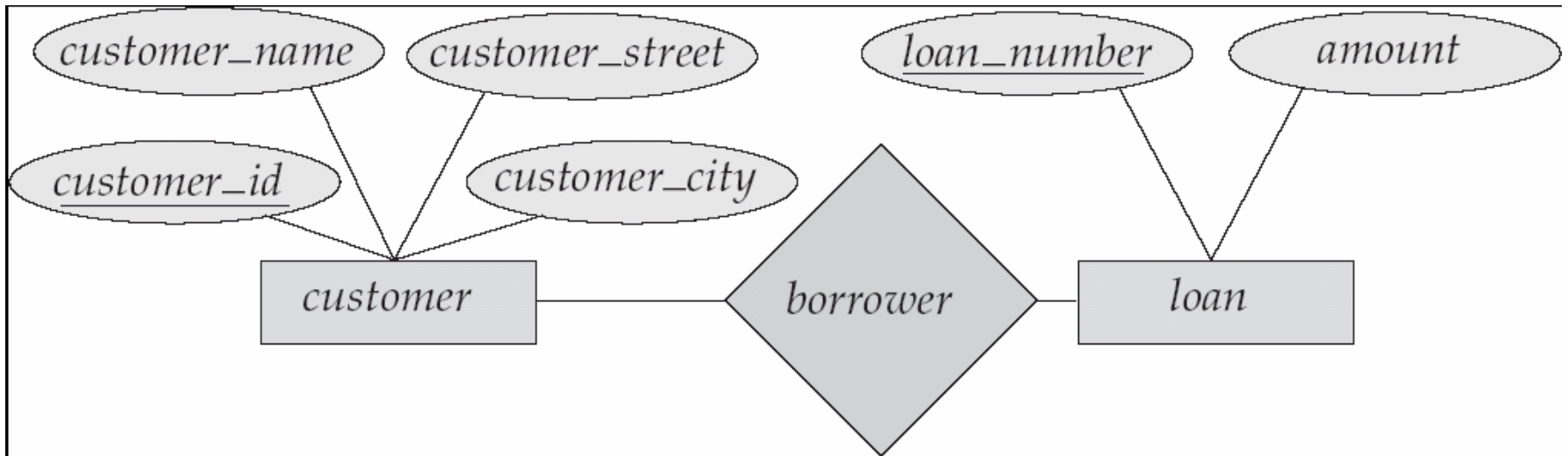
Entity-Relationship (ER) Model

- Elements in a database: data entries
- Data entries represent
 - Entities: data objects, e.g., students, courses, and instructors
 - Relationships among entities: students take courses, instructors teach courses
- ER model: modeling data using entities and relationships

E-R Diagrams

- Rectangles represent entity sets
- Diamonds represent relationship sets
- Lines link attributes to entity sets and entity sets to relationship sets
- Ellipses represent attributes
 - Double ellipses represent multivalued attributes
 - Dashed ellipses denote derived attributes
- Underline indicates primary key attributes

Example

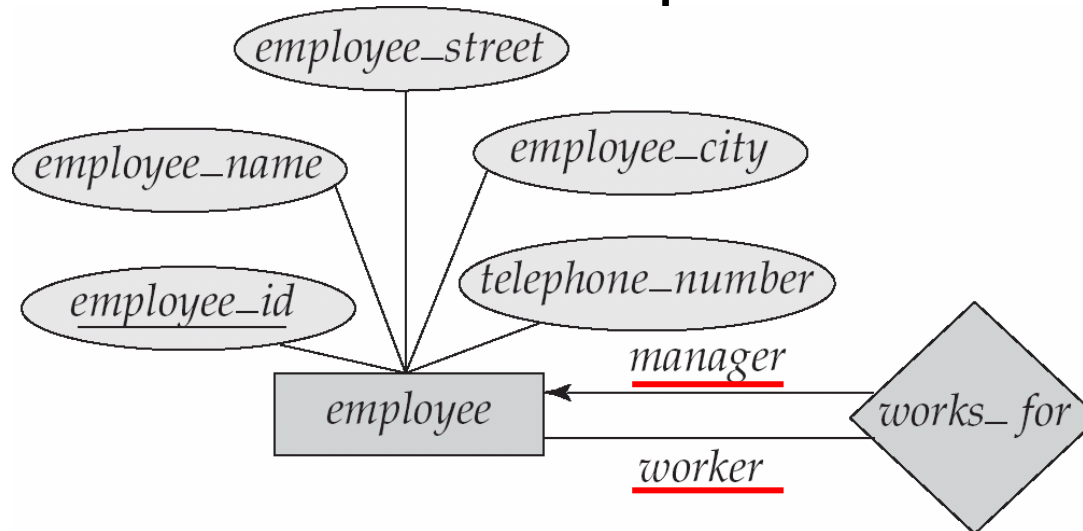


Involving One Entity Set Twice

- Ann and Bob are employees in SmallCompany
 - Two entities in entity set employee
- Ann is Bob's supervisor
 - $(\text{Ann}, \text{Bob}) \in \text{supervision}$
 - Relationship set supervision involves entity set employee twice
 - How can we call the first employee and the second employee in a supervision relationship?

Roles

- The labels “manager” and “worker” are called roles; they specify how employee entities interact via the works_for relationship set
- Role labels are optional, and are used to clarify semantics of the relationship

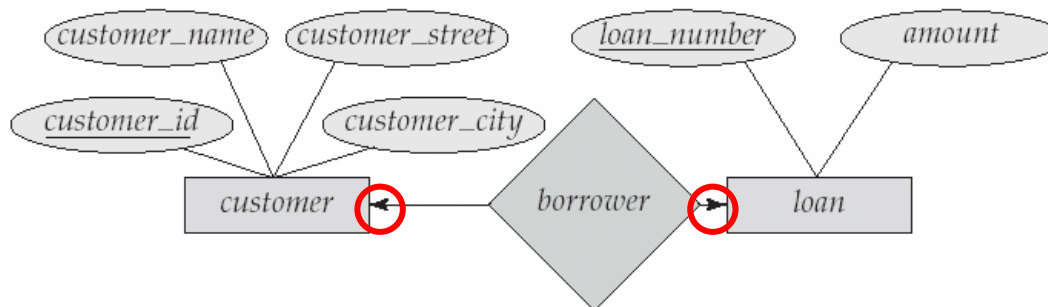


Keys and Mapping Cardinality

- One to one relationship set
 - Use a candidate key in either entity set
 - University-president(university, president)
- Many to one relationship set
 - Use a candidate key in the one side entity set
 - Teaching (instructor, courses)
- Many to many relationship set
 - Use a candidate key in each participating entity set
 - Take-course(student, course)
- How to annotate cardinality constraints in ER diagram?

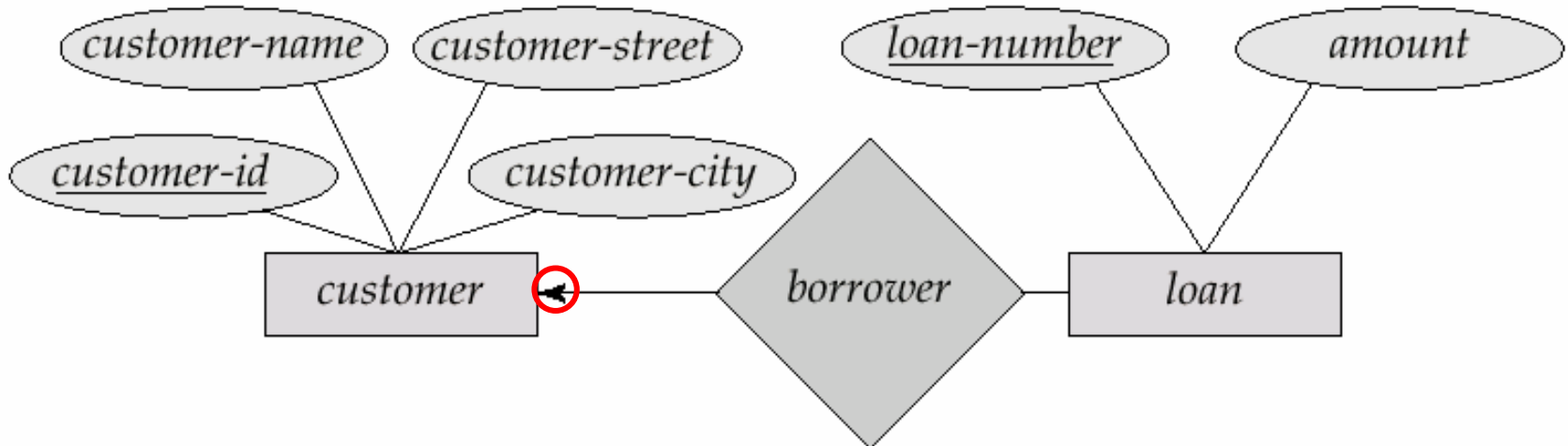
Cardinality Constraints

- Drawing either a directed line (\rightarrow), signifying “one,” or an undirected line (—), signifying “many,” between the relationship set and the entity set.
- One-to-one relationship
 - Each customer can have at most one loan
 - Each loan is associated with at most one customer



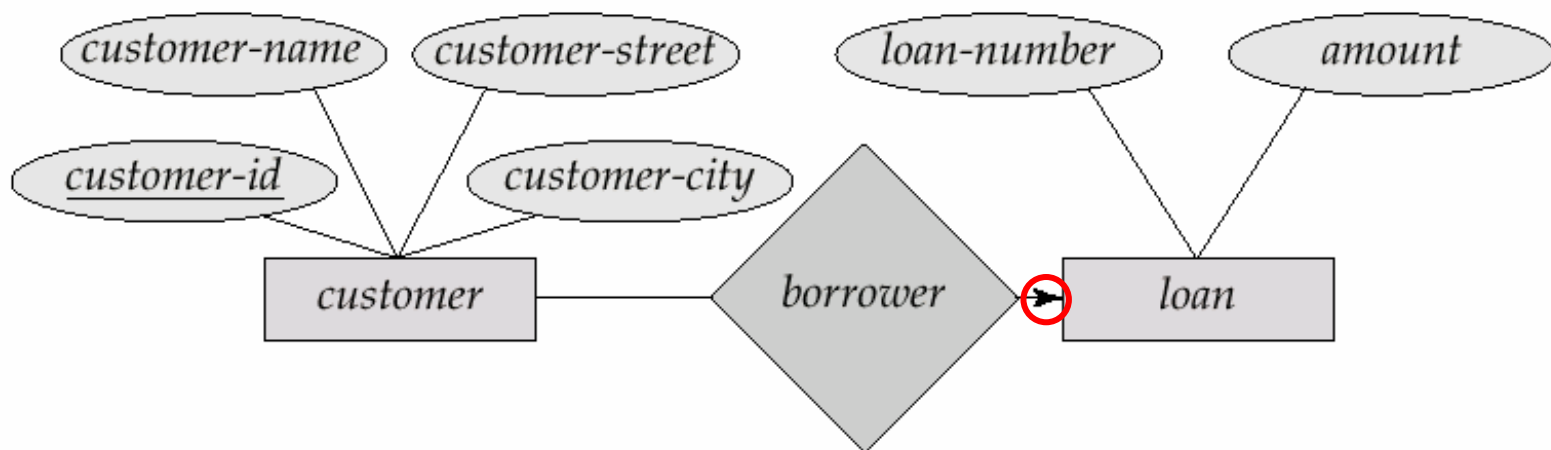
One-To-Many Relationship

- In the one-to-many relationship a loan is associated with at most one customer via borrower, a customer is associated with several (including 0) loans via borrower



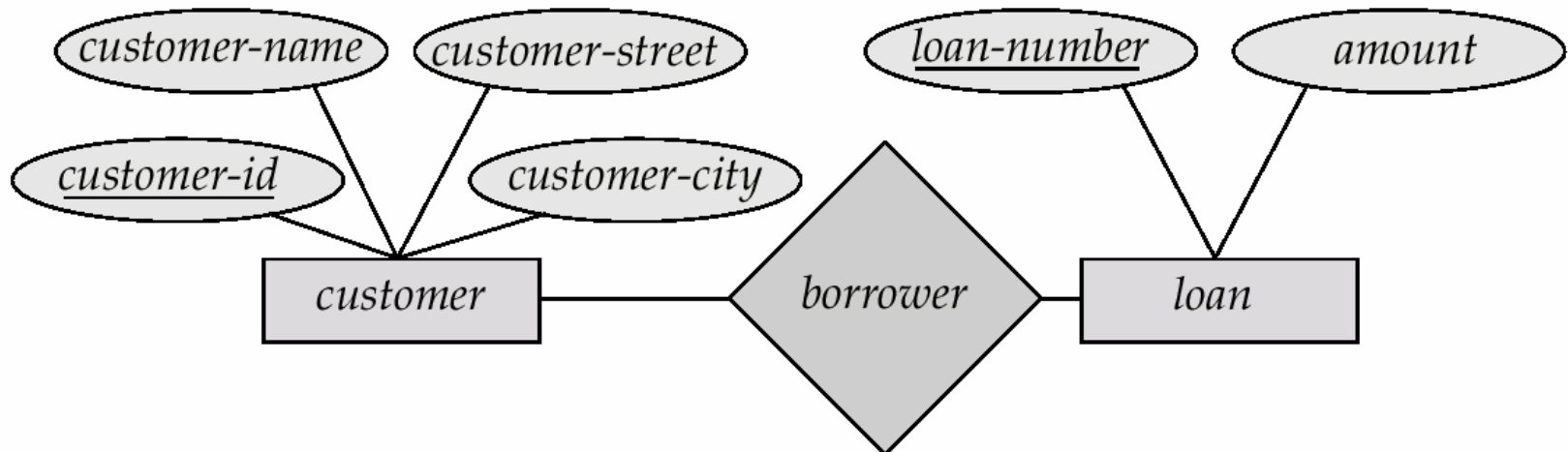
Many-To-One Relationships

- In a many-to-one relationship a loan is associated with several (including 0) customers via borrower, a customer is associated with at most one loan via borrower



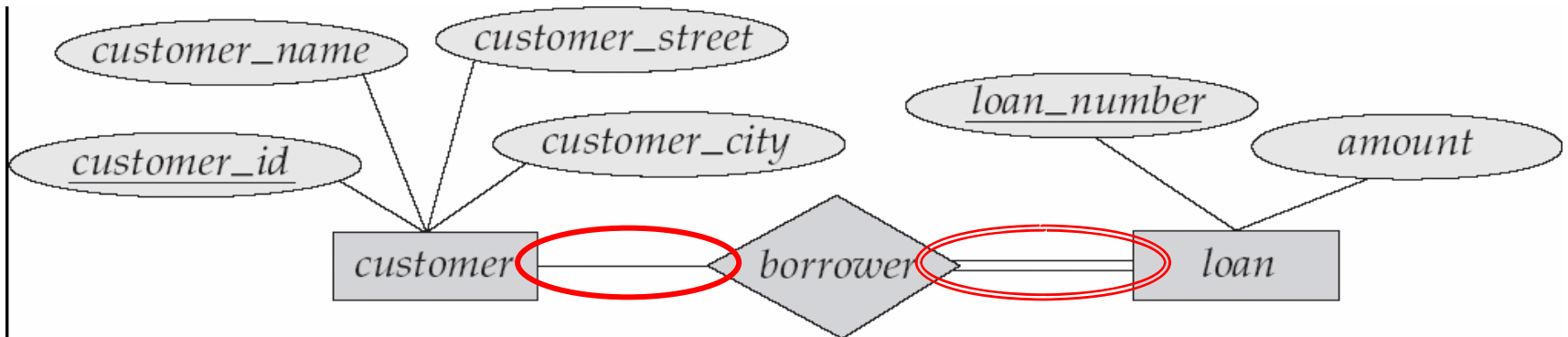
Many-To-Many Relationship

- A customer is associated with several (possibly 0) loans via borrower
- A loan is associated with several (possibly 0) customers via borrower



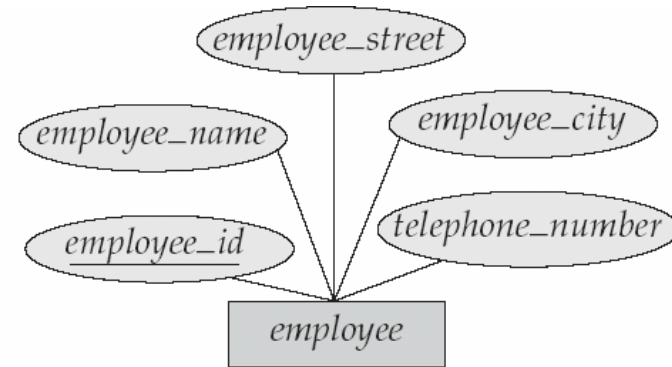
Participation of an Entity Set

- Total participation (indicated by double line): every entity in the entity set participates in at least one relationship in the relationship set
 - E.g., participation of loan in borrower is total: every loan must have a customer associated to it via borrower
- Partial participation: some entities may not participate in any relationship in the relationship set
 - Example: participation of customer in borrower is partial

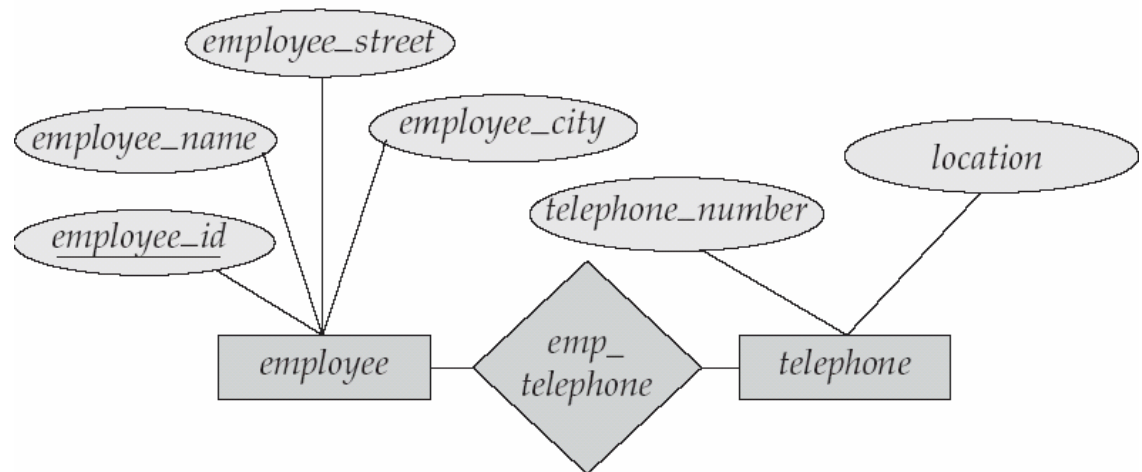


Entity Sets or Attributes

- The structure of the enterprise being modeled
- The semantics associated with the attribute in question



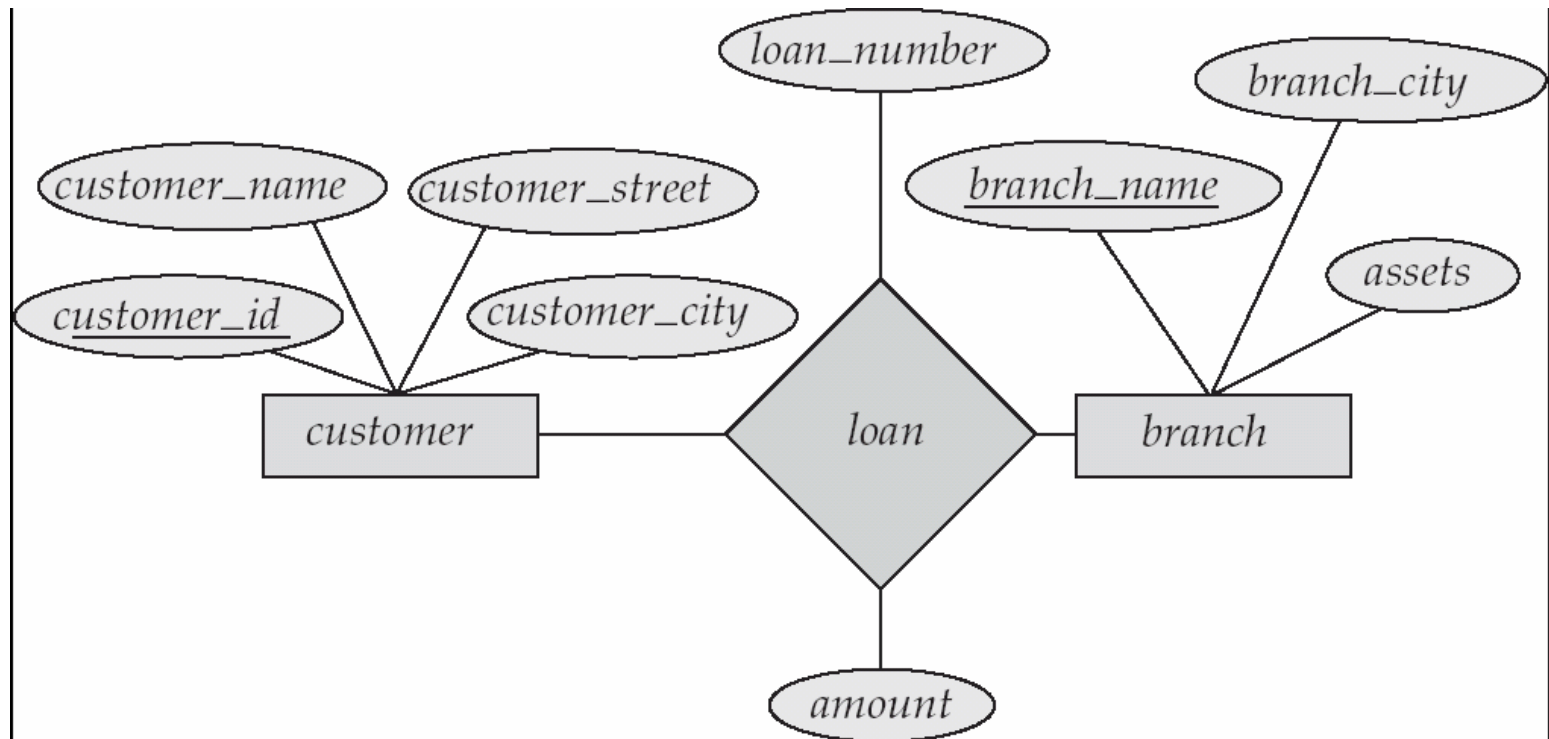
(a)



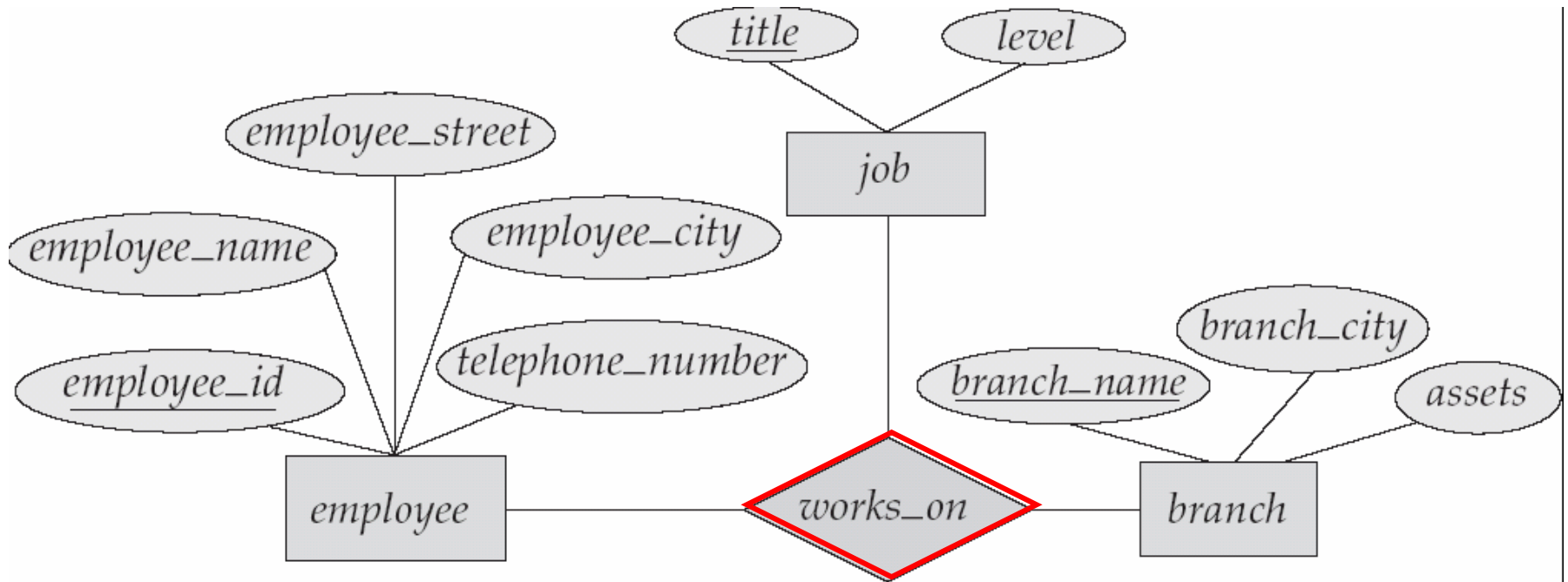
(b)

Entity Sets or Relationship Sets

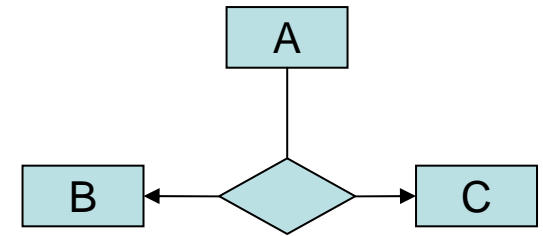
- Designate a relationship set to describe an action that occurs between entities



A Ternary Relationship



Cardinality Constraints



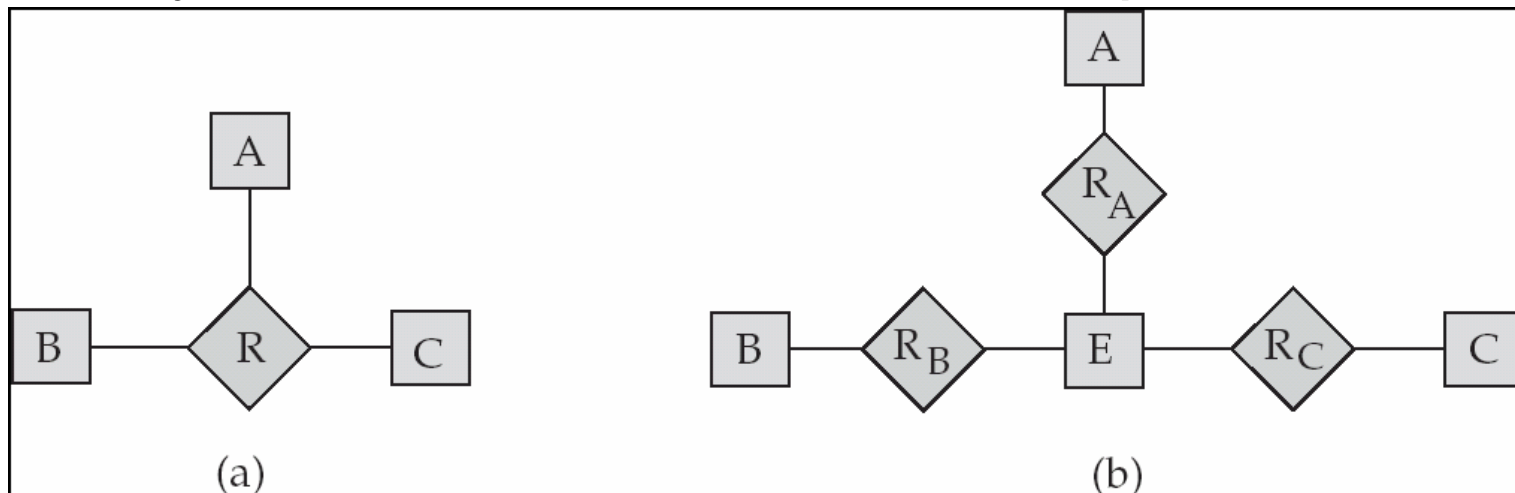
- At most one arrow out of a ternary (or greater degree) relationship to indicate a cardinality constraint
 - An arrow from works_on to job indicates each employee works on at most one job at any branch
- Confusion with more than one arrow
 - Each A entity is associated with a unique entity from B and C (i.e., a combination of B and C), or
 - Each pair of entities from (A, B) is associated with a unique C entity, and each pair (A, C) is associated with a unique B

Binary vs. Non-Binary Relationships

- Some non-binary relationships may be better represented using binary relationships
 - E.g. A ternary relationship parents, relating a child to his/her father and mother, is best replaced by two binary relationships, father and mother
 - Using two binary relationships allows partial information (e.g. only mother being know)
- But there are some relationships that are naturally non-binary, e.g., works_on

Converting Non-Binary Relationships

- A non-binary relationship can be represented using binary relationships by creating an artificial entity set
 - Replace R between entity sets A, B and C by an entity set E, and three relationship sets:



Summary

- Roles
- Cardinality constraints
- Participation
- Choice of entity sets attributes, or relationship sets
- Binary and non-binary relationships

To-Do-List

- Can you think about some situations where the facilities of ER design we have so far are still insufficient to model the application data?