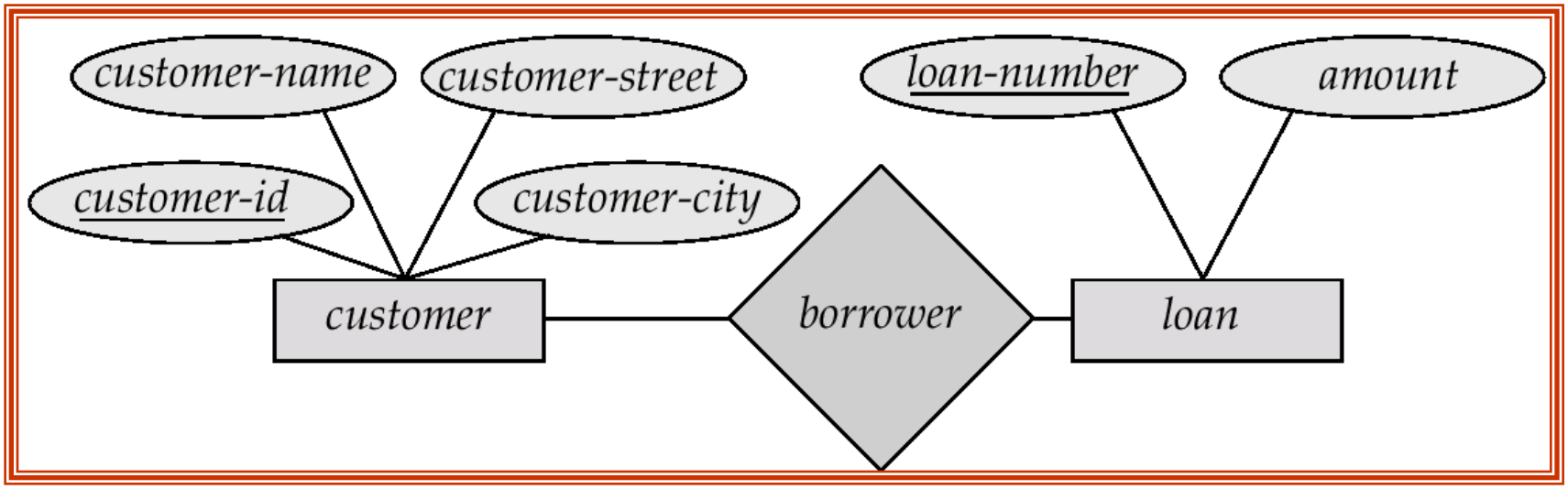
# Entity, Relationship, and E-R Diagram

- A *database* can be modeled as:
  - **a collection of entities,**
  - **relationship among entities.**
- A *database* can be illustrated by an E-R diagram

# E-R Diagrams

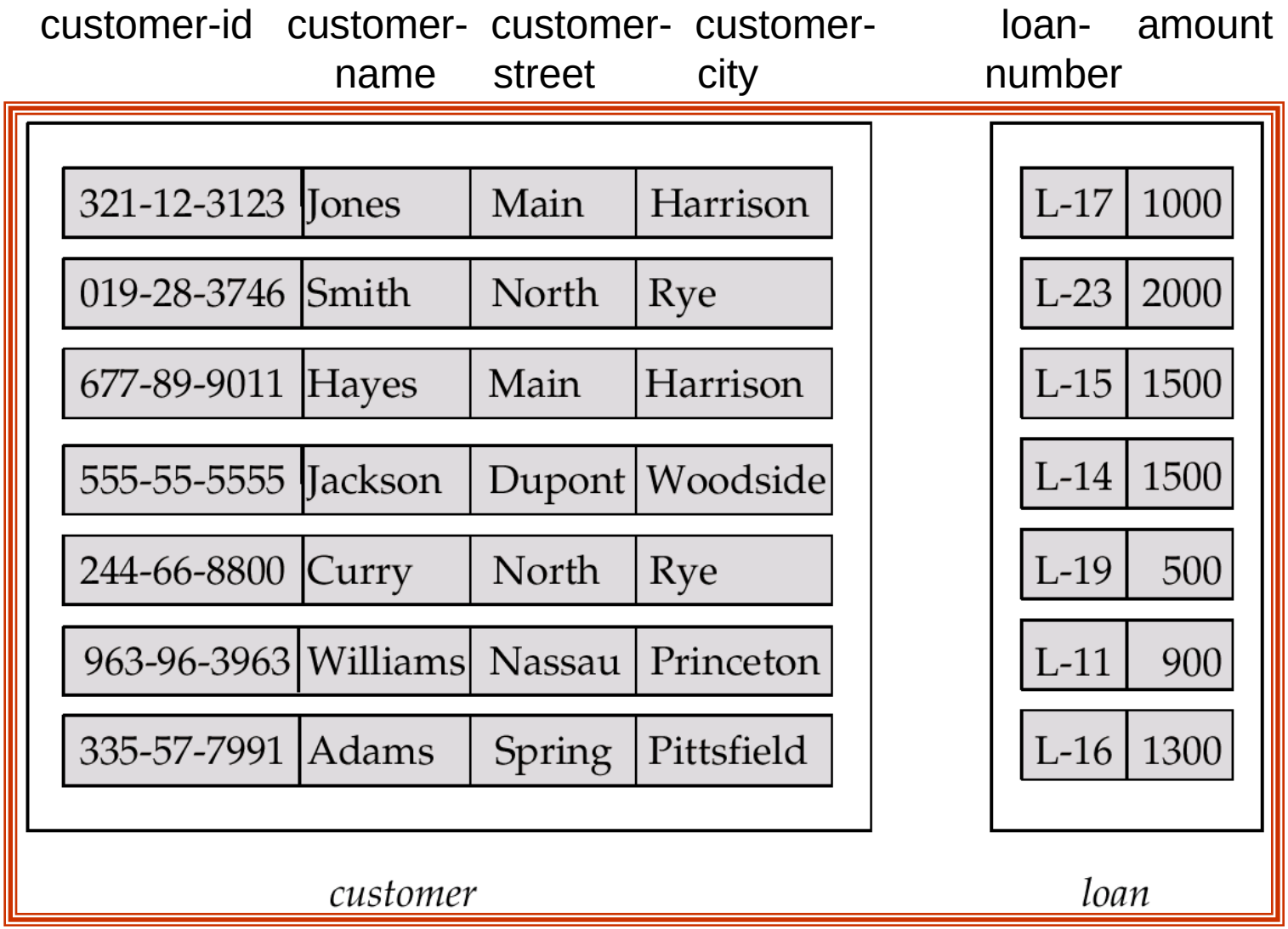



- **Rectangles** represent entity sets.
- **Diamonds** represent relationship sets.
- **Lines** link attributes to entity sets and entity sets to relationship sets.
- **Ellipses** represent attributes
  - **Double ellipses** represent multivalued attributes
  - **Dashed ellipses** denote derived attributes.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

# Entity Sets

- An *entity* is an object that exists and is distinguishable from other objects.
  - Example:  specific person, company, event, plant
- Entities have *attributes*
  - **Example: people have *names* and *addresses***
- An *entity set* is a set of entities of the same type that share the same properties.
  - **Example: set of all persons, companies, trees, holidays**

# Entity Sets *customer* and *loan*



| customer-id | customer-name | customer-street | customer-city |
|---|---|---|---|
| 321-12-3123 | Jones | Main | Harrison |
| 019-28-3746 | Smith | North | Rye |
| 677-89-9011 | Hayes | Main | Harrison |
| 555-55-5555 | Jackson | Dupont | Woodside |
| 244-66-8800 | Curry | North | Rye |
| 963-96-3963 | Williams | Nassau | Princeton |
| 335-57-7991 | Adams | Spring | Pittsfield |

*customer*

| loan-number | amount |
|---|---|
| L-17 | 1000 |
| L-23 | 2000 |
| L-15 | 1500 |
| L-14 | 1500 |
| L-19 | 500 |
| L-11 | 900 |
| L-16 | 1300 |

*loan*

# Attributes

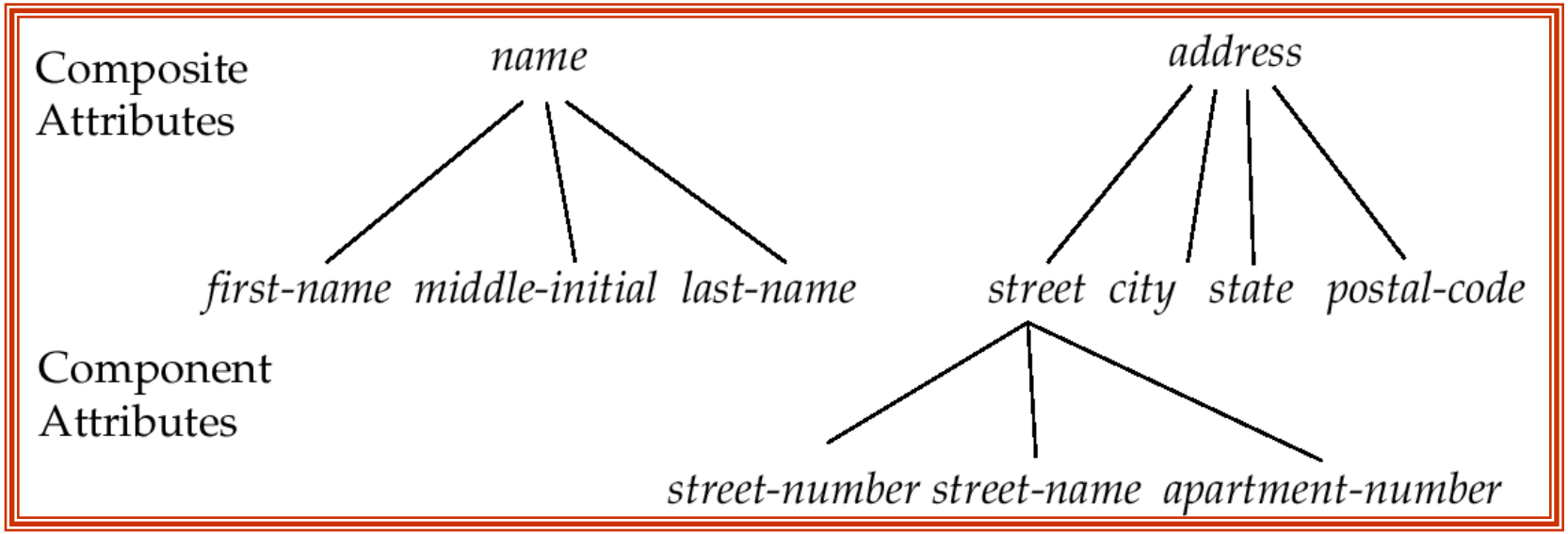
- An entity is represented by a set of attributes, that is descriptive properties possessed by all members of an entity set.

  Example:

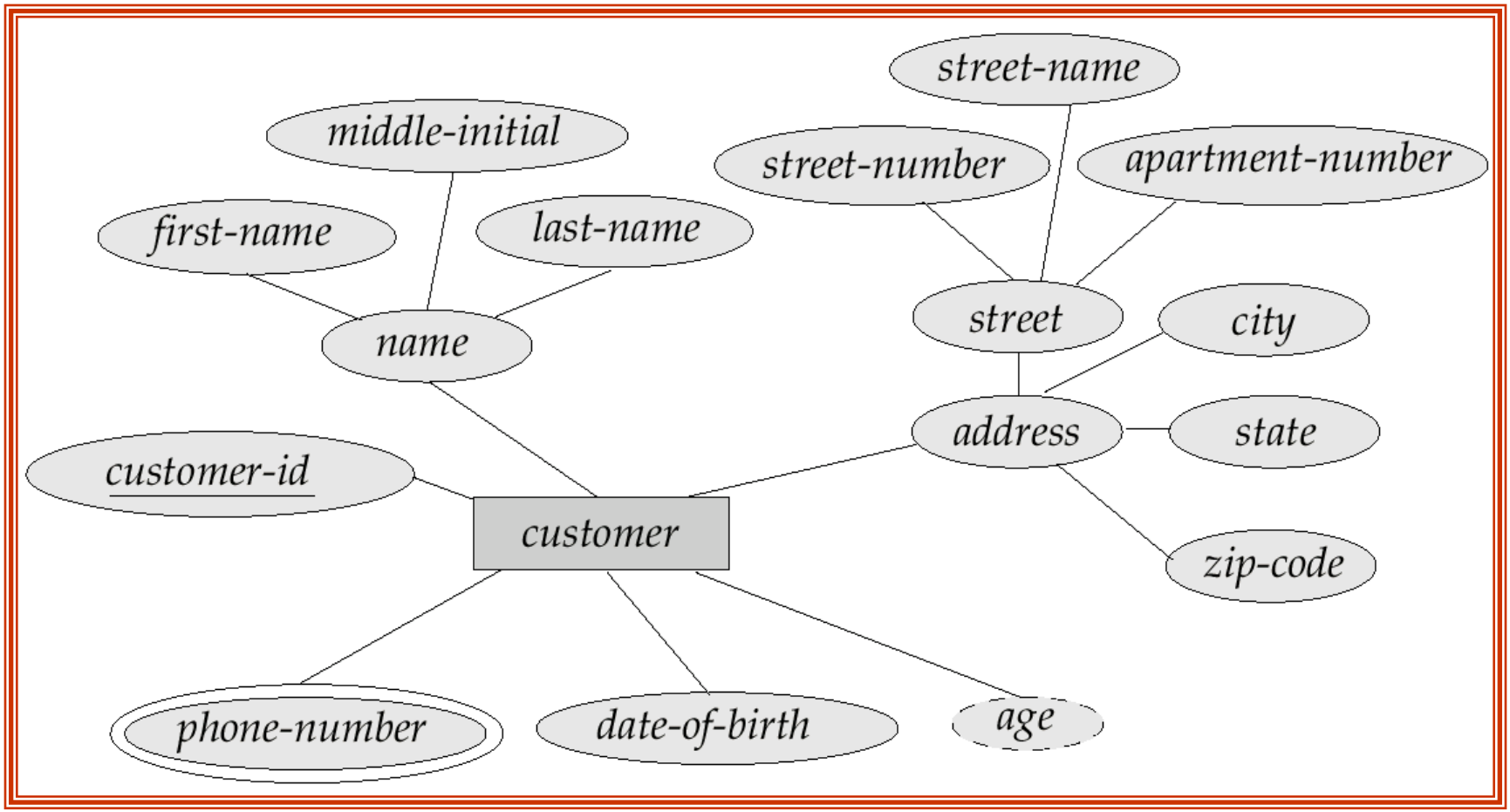
  *customer = (customer-id, customer-name, customer-street, customer-city)*
  *loan = (loan-number, amount)*

- *Domain* – the set of permitted values for each attribute
- Attribute types:
  - ***Simple* and *composite* attributes.**
  - ***Single-valued* and *multi-valued* attributes**
    - **E.g. multivalued attribute: *phone-numbers***
  - ***Derived* attributes**
    - **Can be computed from other attributes**
    - **E.g. *age*, given date of birth**

# Composite Attributes



# E-R Diagram With Composite, Multivalued, and Derived Attributes

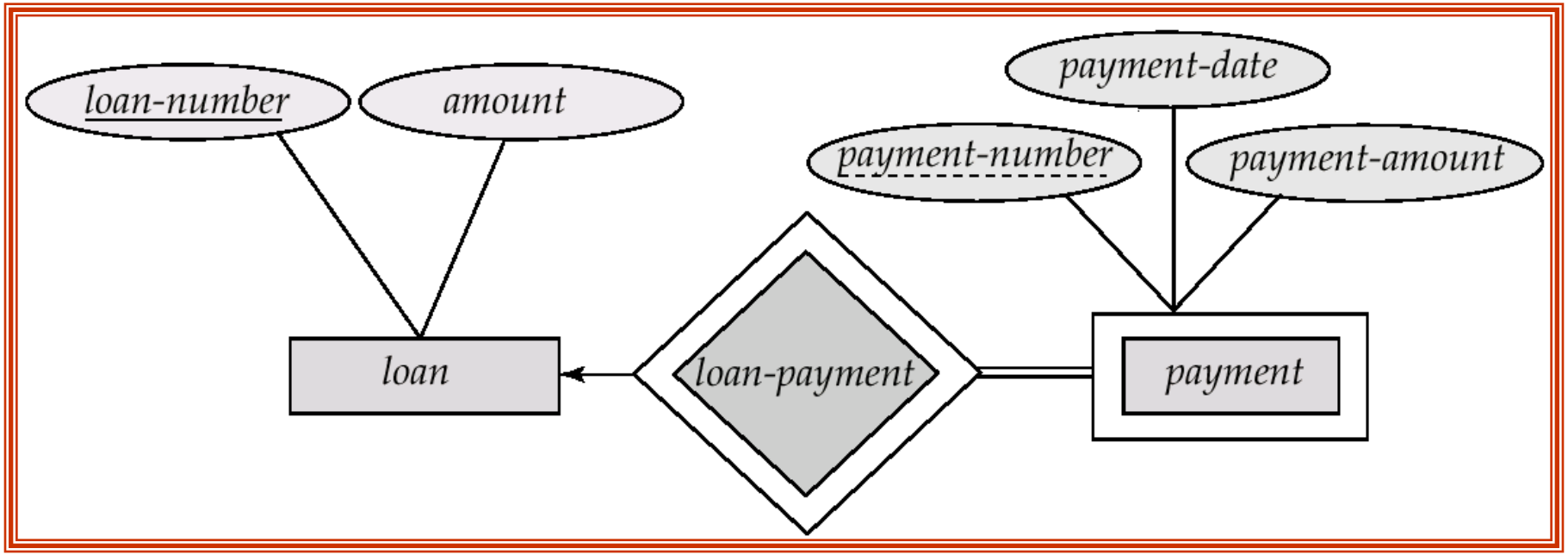


# Weak Entity and Regular/Strong Entity

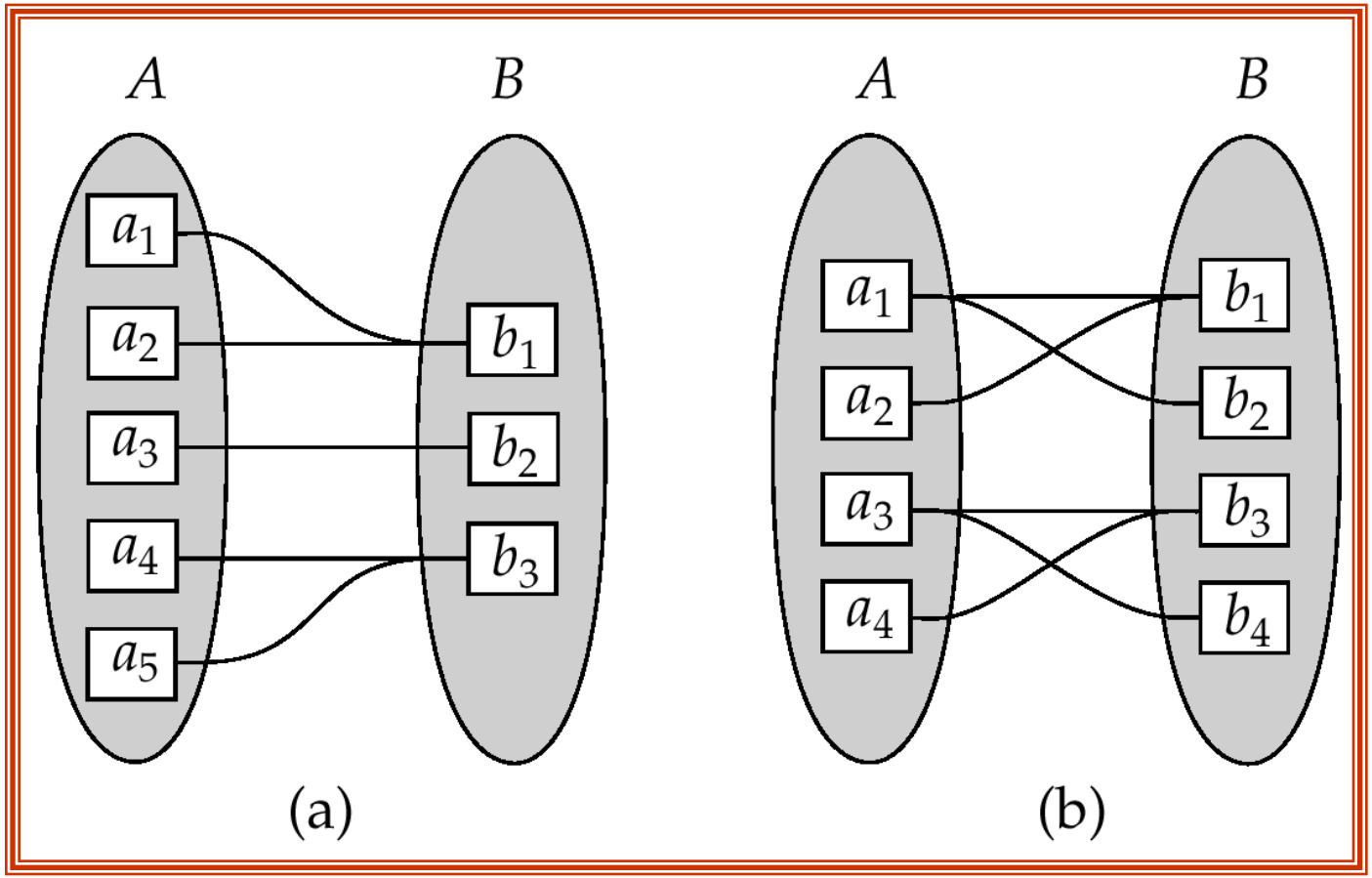
- *A weak entity* is an entity that is existence-dependent on some other entity. By contrast, *a regular entity* (or "a strong entity") is an entity which is not weak.
- The existence of a weak entity set depends on the existence of a *identifying entity set*
  - it must relate to the identifying entity set via a total, one-to-many relationship set from the identifying to the weak entity set
- E.g. An employee's dependents might be weak entities --- they can't exist (so far as the database is concerned) if the relevant employee does not exist.
- A weak entity type can be related to more than one regular entity type.

# Weak Entity and Regular/Strong Entity

- We depict a weak entity by double rectangles.
- The identifying relationship is depicted using a double diamond.



# Mapping Cardinalities



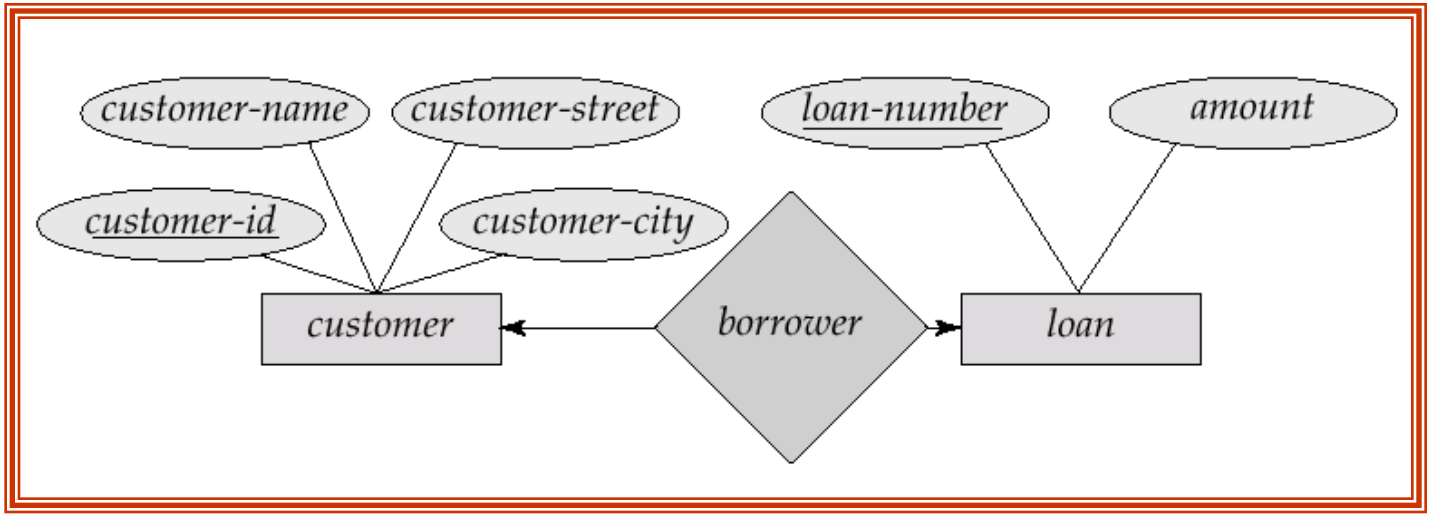

Many to one

Many to many

Note: Some elements in A and B may not be mapped to any elements in the other set

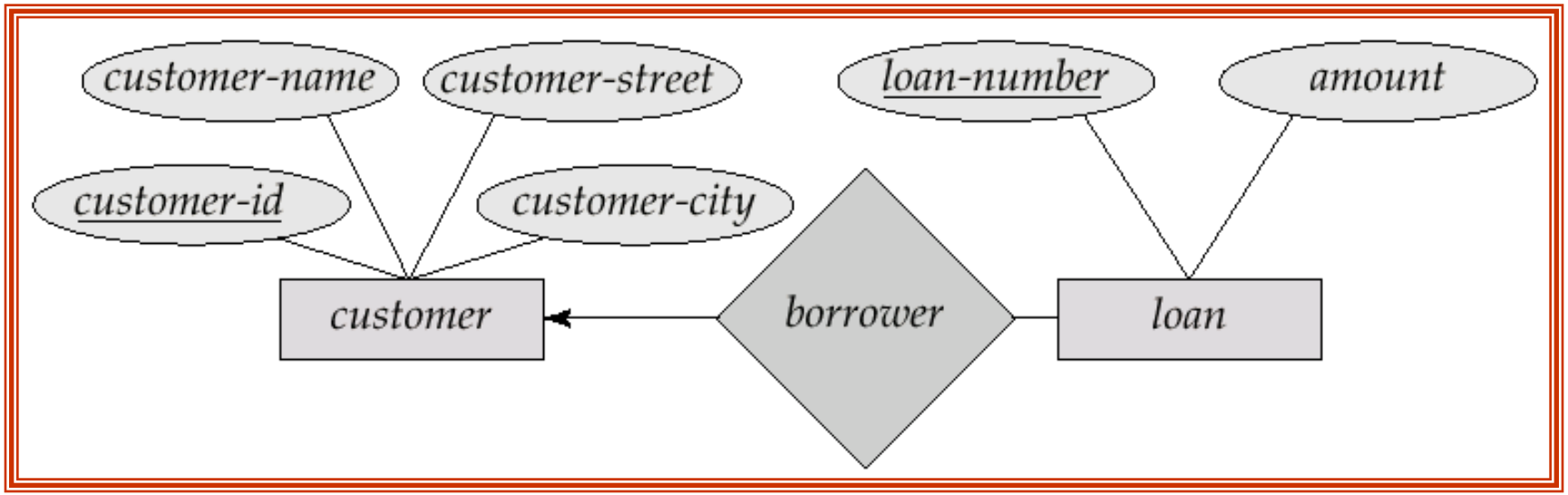
# Mapping Cardinality

- We express cardinality constraints by drawing either a directed line (→), signifying "one," or an undirected line (—), signifying "many," between the relationship set and the entity set.
- E.g.: One-to-one relationship:
  - **A customer is associated with at most one loan via the relationship *borrower***
  - **A loan is associated with at most one customer via *borrower***



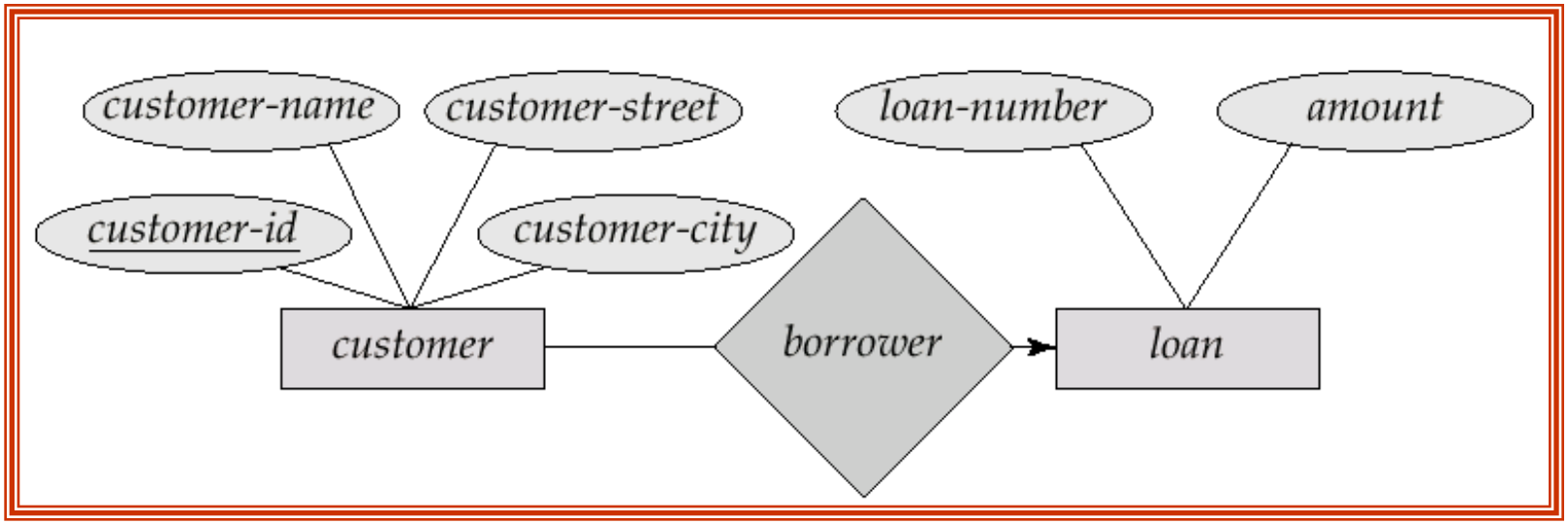
# One-To-Many Relationship

- 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*

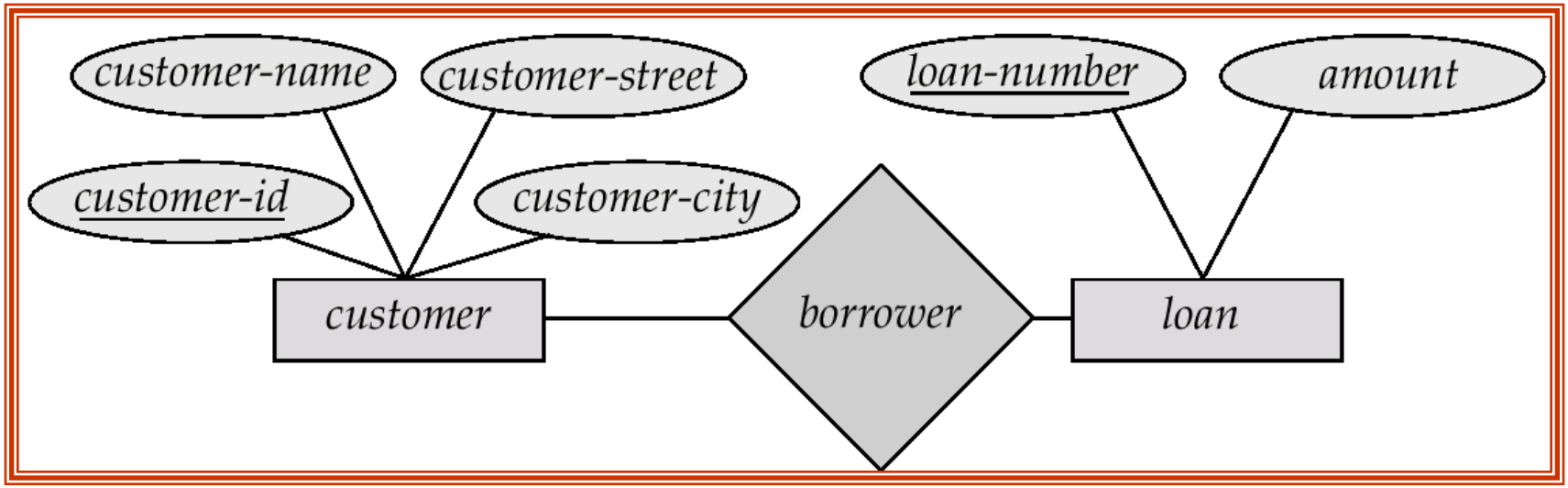


# Many-To-One Relationships

- 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*

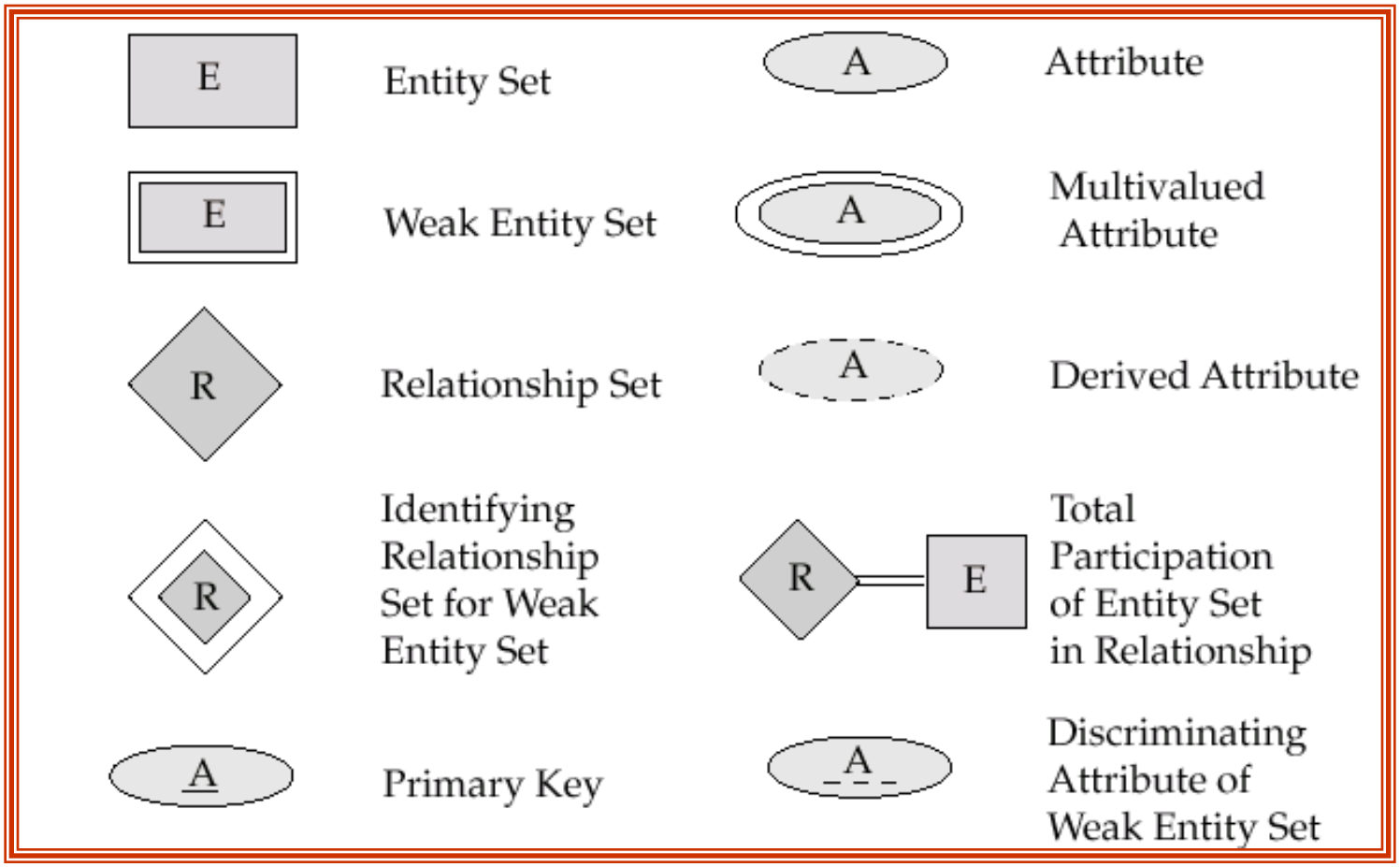


# Many-To-Many Relationship

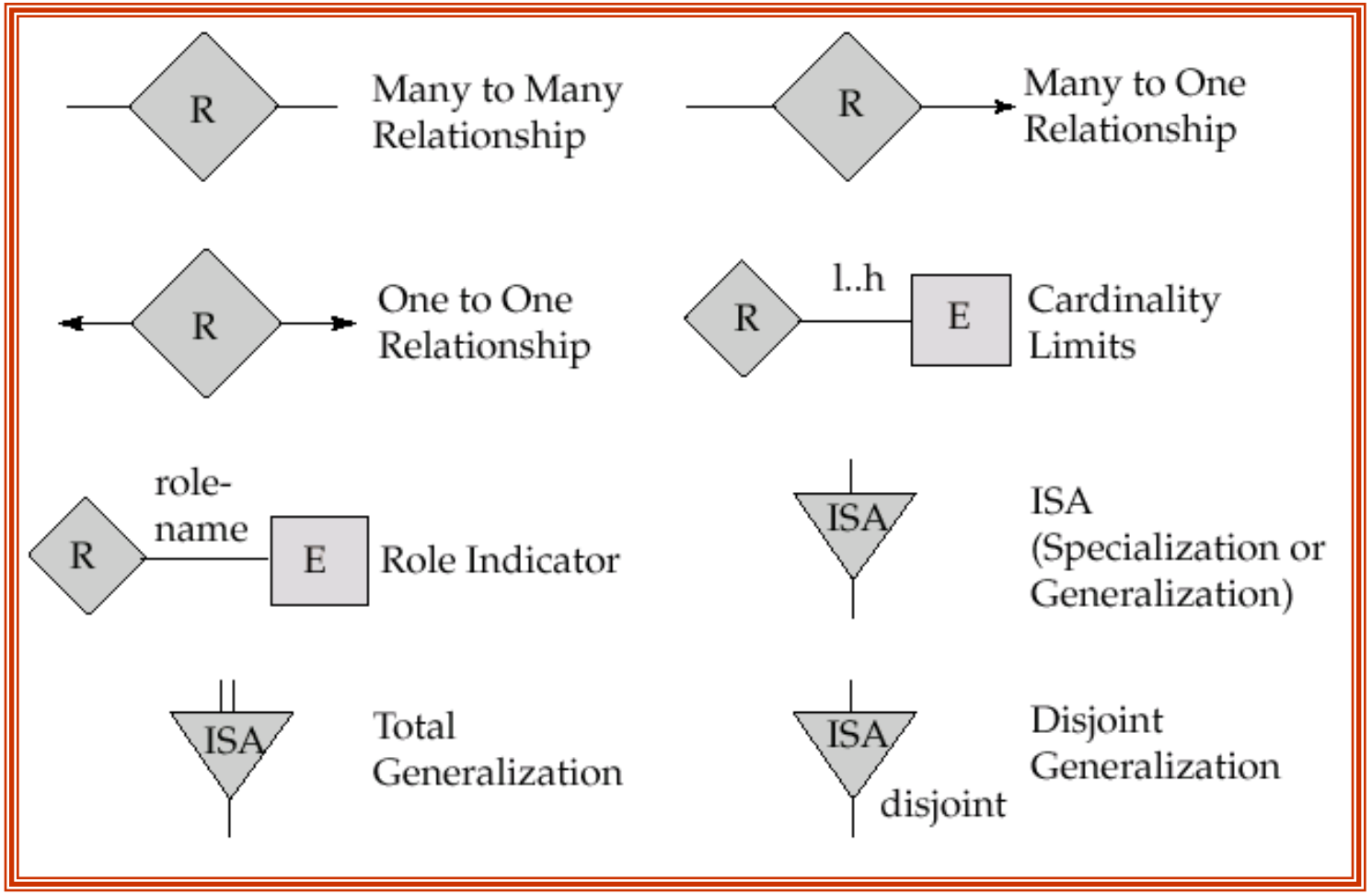



- A customer is associated with several (possibly 0) loans via borrower
- A loan is associated with several (possibly 0) customers via borrower

# Summary of Symbols Used in E-R Notation

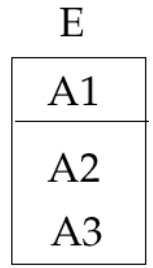


# Summary of Symbols (Cont.)

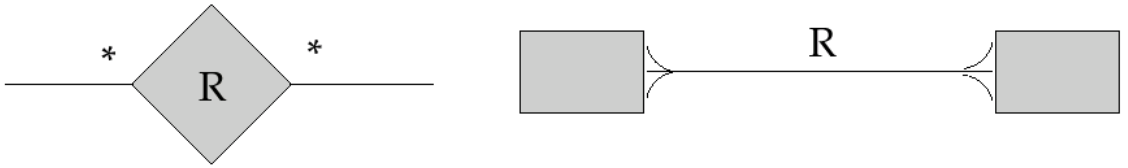


# Alternative E-R Notations

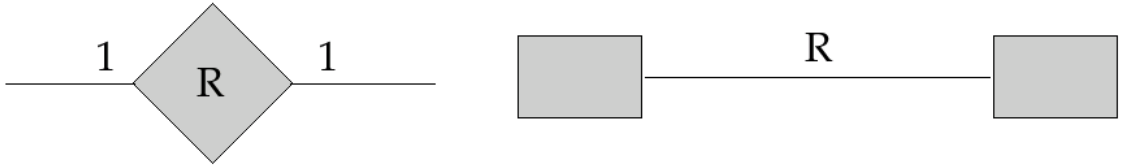
Entity set E with attributes A1, A2, A3 and primary key A1




Many to Many Relationship




One to One Relationship




Many to One Relationship