

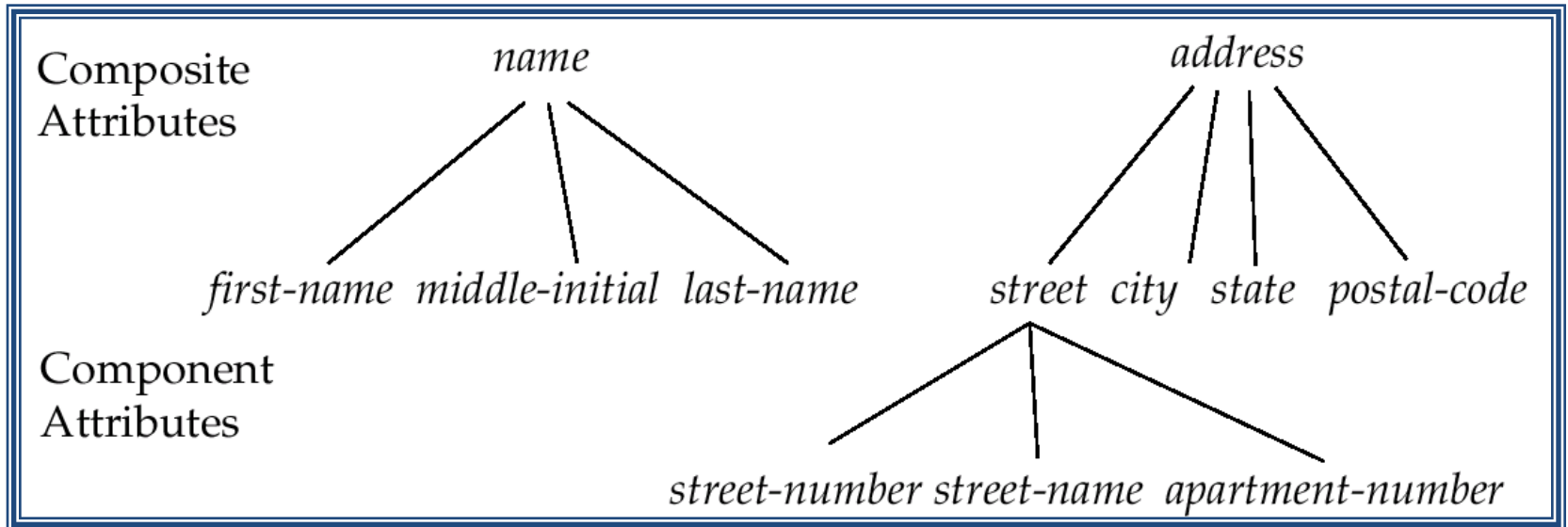
Entity-Relationship Model

1. Entity
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3. Entity Sets
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9. E-R Diagram
10. Extended E-R Features
11. Design of an E-R Database Schema
12. Reduction of an E-R Schema to Tables

Attribute types:

1. *Simple and composite* attributes.
2. *Single-valued and multi-valued* attributes
E.g. multivalued attribute: *phone-numbers*
3. *Derived* attributes
Can be computed from other attributes
E.g. *age*, given date of birth

Composite Attributes



Composite and Multi-valued Attributes

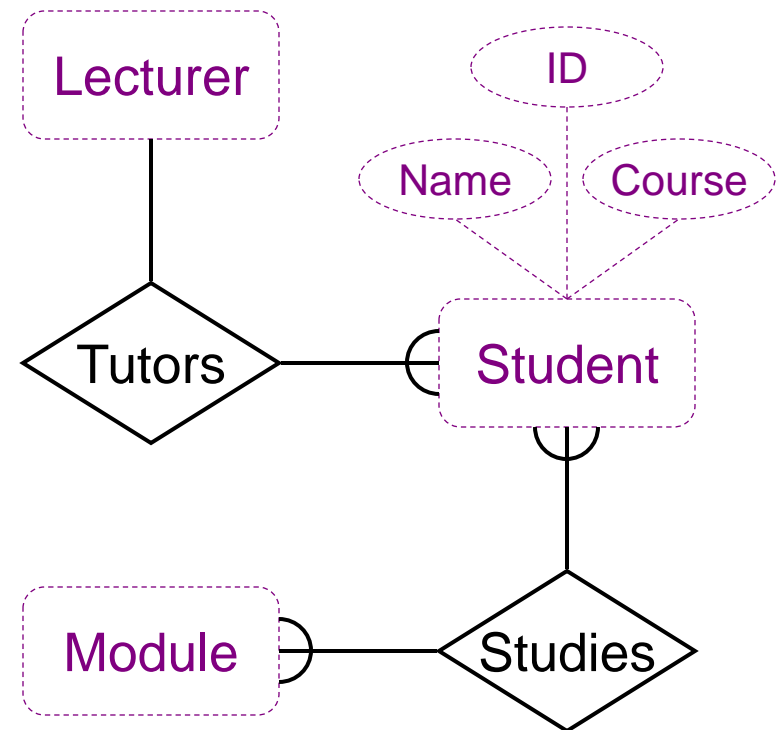
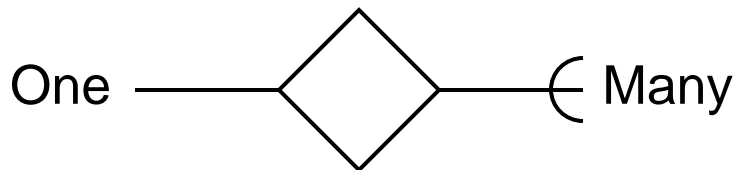
- Composite attributes are flattened out by creating a separate attribute for each component attribute
 - E.g. given entity set *customer* with composite attribute *name* with component attributes *first-name* and *last-name* the table corresponding to the entity set has two attributes *name.first-name* and *name.last-name*
- A multivalued attribute M of an entity E is represented by a separate table EM
 - Table EM has attributes corresponding to the primary key of E and an attribute corresponding to multivalued attribute M
 - E.g. Multivalued attribute *dependent-names* of *employee* is represented by a table *employee-dependent-names(employee-id, dname)*
 - Each value of the multivalued attribute maps to a separate row of the table EM
 - E.g., an employee entity with primary key John and dependents Johnson and Johndotir maps to two rows: (John, Johnson) and (John, Johndotir)

Relationships

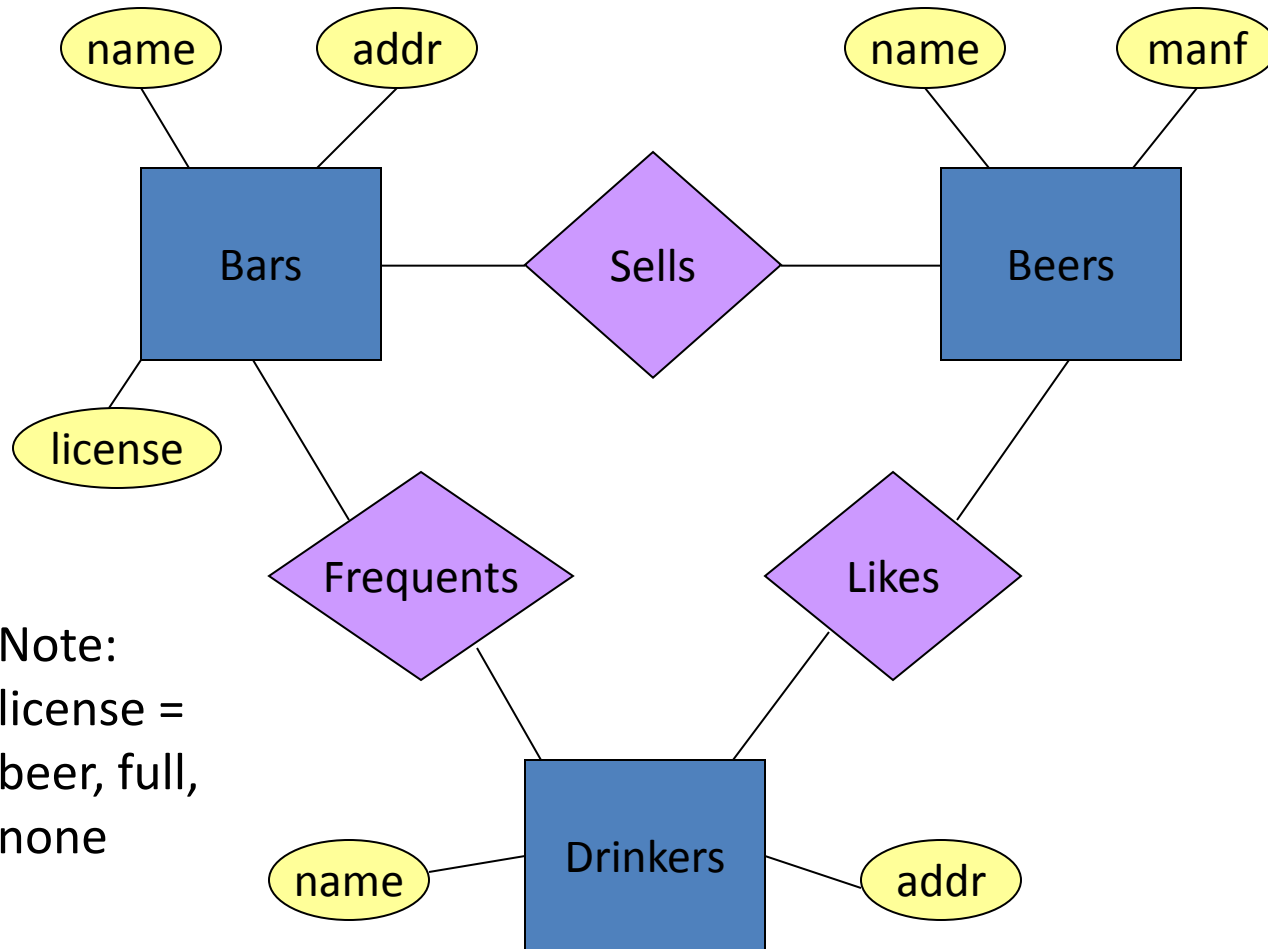
- Relationships are an association between two or more entities
 - Each Student takes several Modules
 - Each Module is taught by a Lecturer
 - Each Employee works for a single Department
- A relationship connects two or more entity sets.
- It is represented by a diamond, with lines to each of the entity sets involved.
- Relationships have
 - A name
 - A set of entities that participate in them
 - A degree - the number of entities that participate (most have degree 2)
 - Higher degrees leads to complex ER Diagrams.
 - A cardinality ratio

Diagramming Relationships

- Relationships are links between two entities
- The name is given in a diamond box
- The ends of the link show cardinality



Example: Relationships



Bars sell some beers.

Drinkers like some beers.

Drinkers frequent some bars.

Note:
license =
beer, full,
none

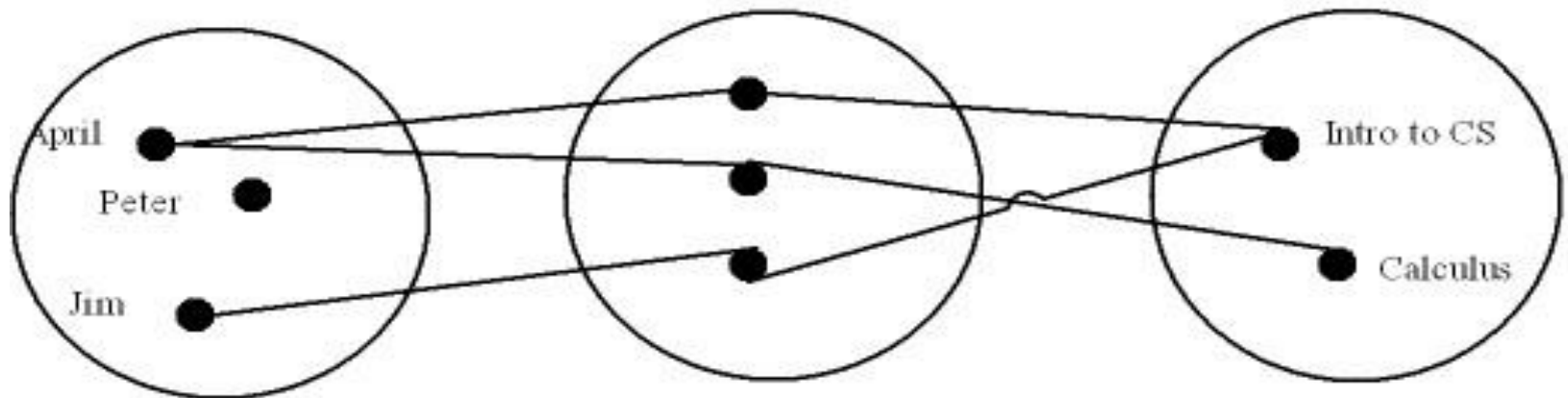
Relationship Set

- The current “value” of an entity set is the set of entities that belong to it.
 - **Example**: the set of all bars in our database.
- The “value” of a relationship is a *relationship set*, a set of tuples with one component for each related entity set.

A relationship set is a set of relationships of the same type. Formally it is a mathematical relation on (possibly non-distinct) sets. If E_1 and E_2 are entity sets, then a relationship set R is a subset of $E_1 \times E_2$. For example, consider the two entity sets customer and account. Sep 10, 1995

An Relationship Set is a collection of relationships all belonging to one relationship type. In the set are instances of relationships. For instance, if a relationship type is registration then each enrollment of a student in a course is an instance of registration and appears in the relationship set.

April is taking two courses
Peter is taking zero courses
Jim is taking one course



Student Entity Set
with 3 student entities

Register
Relationship
Set with 3 relationships

Course Entity Set
with 2 course entities

Example: Relationship Set

- For the relationship **Sells**, we might have a relationship set like:

Bar	Beer
Joe's Bar	Bud
Joe's Bar	Miller
Sue's Bar	Bud
Sue's Bar	Pete's Ale
Sue's Bar	Bud Lite

Relationship Sets

- A **relationship** is an association among several entities

Example:

Hayes depositor A-102
customer entity relationship set *account* entity

- A **relationship set** is a mathematical relation among $n \geq 2$ entities, each taken from entity sets

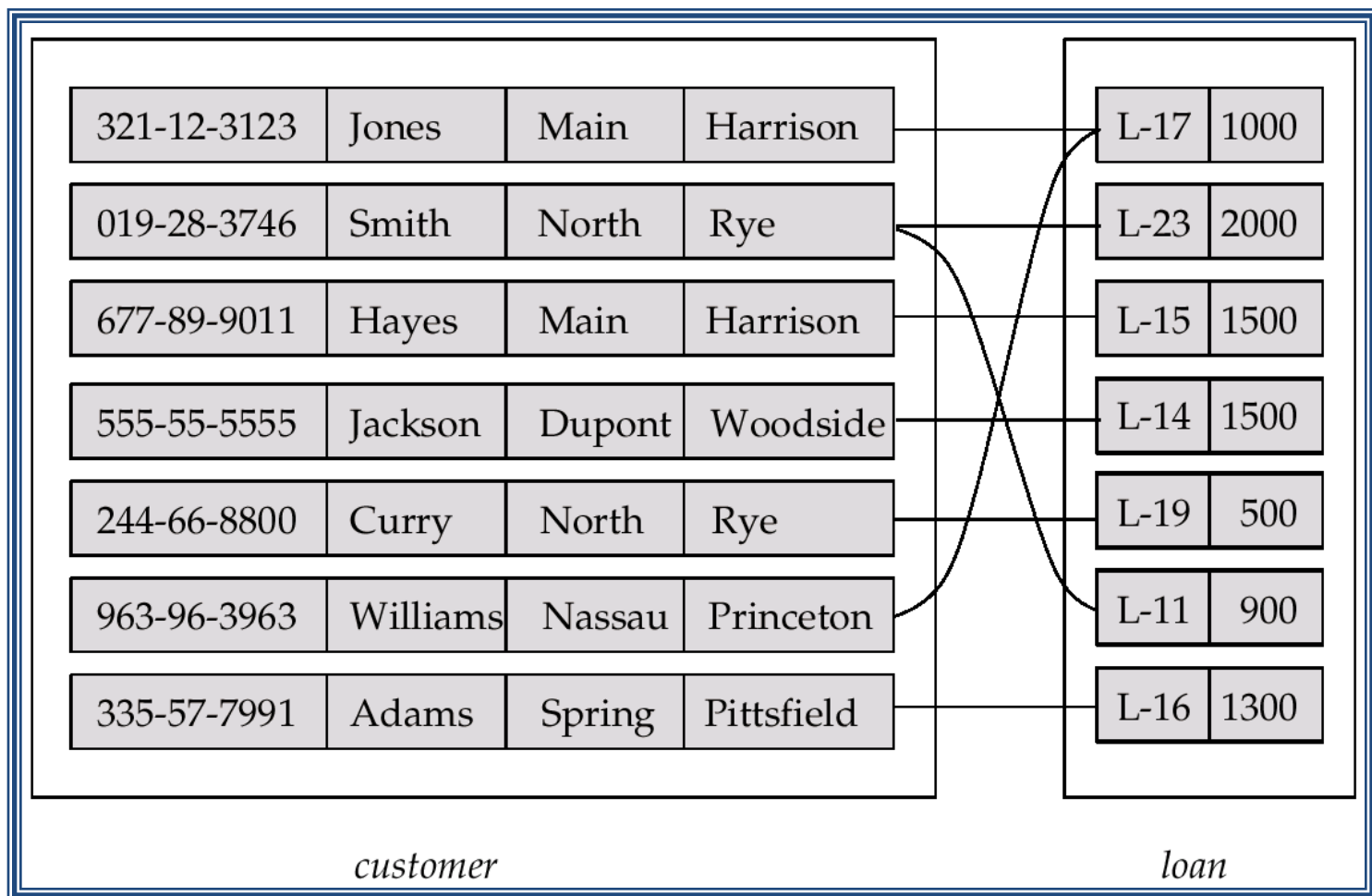
$$\{(e_1, e_2, \dots, e_n) \mid e_1 \in E_1, e_2 \in E_2, \dots, e_n \in E_n\}$$

where (e_1, e_2, \dots, e_n) is a relationship

– Example:

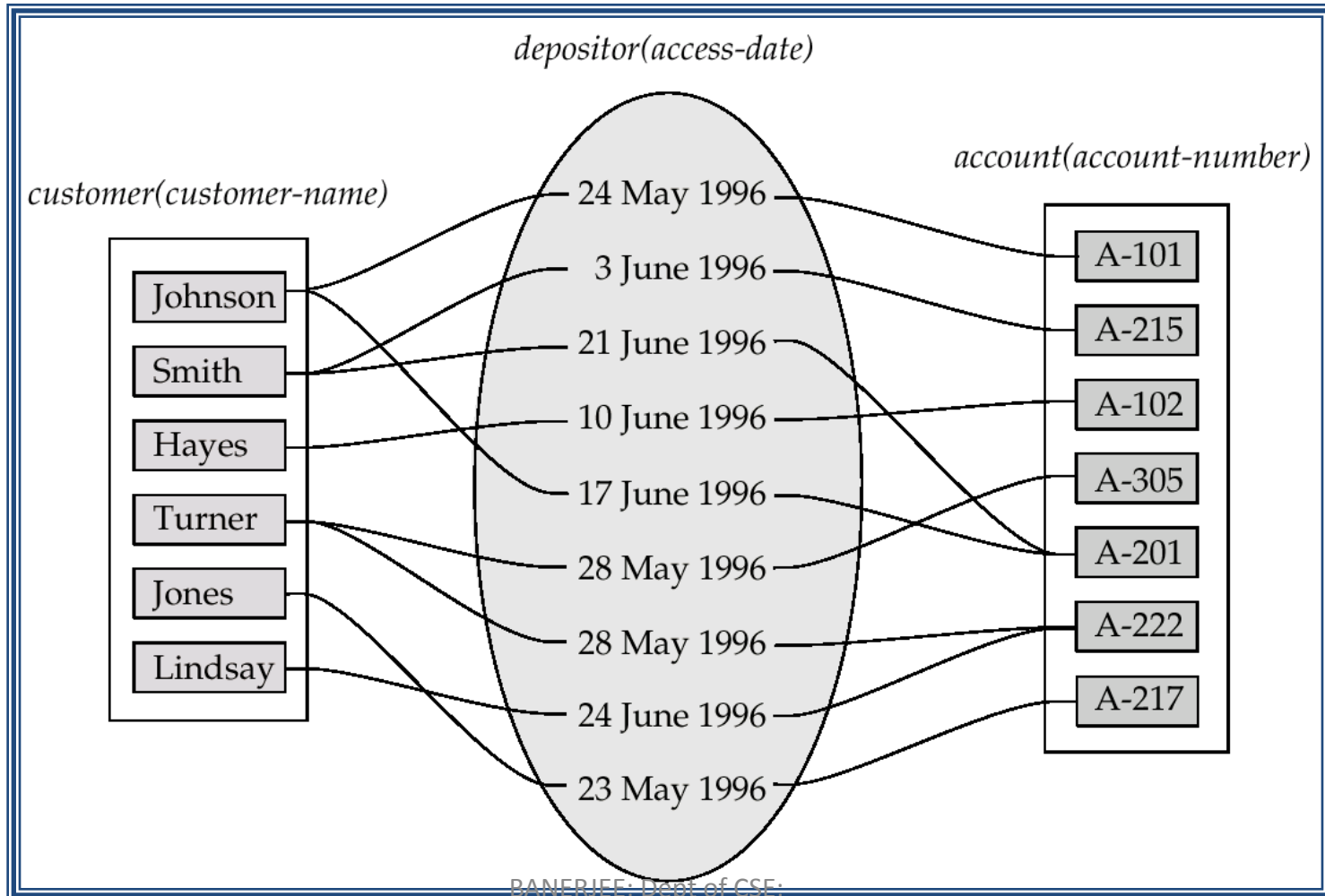
$$(\text{Hayes}, \text{A-102}) \in \text{depositor}$$

Relationship Set *borrower*



Relationship Sets (Cont.)

- An *attribute* can also be property of a relationship set.
- For instance, the *depositor* relationship set between entity sets *customer* and *account* may have the attribute *access-date*



A Typical Relationship Set

Bar	Drinker	Beer
Joe's Bar Ann	Miller	
Sue's Bar Ann	Bud	
Sue's Bar Ann	Pete's Ale	
Joe's Bar Bob	Bud	
Joe's Bar Bob	Miller	
Joe's Bar Cal	Miller	
Sue's Bar Cal	Bud Lite	

Degree of a Relationship Set

- Refers to number of entity sets that participate in a relationship set.
- Relationship sets that involve two entity sets are *binary* (or degree two). Generally, most relationship sets in a database system are binary.
- Relationship sets may involve more than two entity sets.

👉 E.g. Suppose employees of a bank may have jobs (responsibilities) at multiple branches, with different jobs at different branches. Then there is a ternary relationship set between entity sets *employee*, *job* and *branch*

- Relationships between more than two entity sets are rare. Most relationships are binary. (More on this later.)