

CSc 134

Database Management and File Organization

2. Entity-Relationship Model

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Entity-Relationship Model



- Conceptual Model
- Entity, Relationship
- ER Diagram

Entity and Attribute

- Entity
 - An object with a physical existence or conceptual existence
 - e.g. a person, a company
 - Notation
- Attributes
 - Properties that describe entities
 - e.g. Name of an employee
 - Notation

Attribute

- Simple vs. Composite attribute

- Simple (atomic) attribute
 - Attribute that are not divisible
 - e.g. SSN, ZIP code
 - Notation
- Composite Attribute
 - can be divided into smaller subparts
 - e.g. Address
 - Notation

Attribute

- Single value vs. Multivalued attribute

- Single-valued attribute
 - e.g. Age of a person
- Multivalued attribute
 - e.g. College degree
 - Notation

Attribute

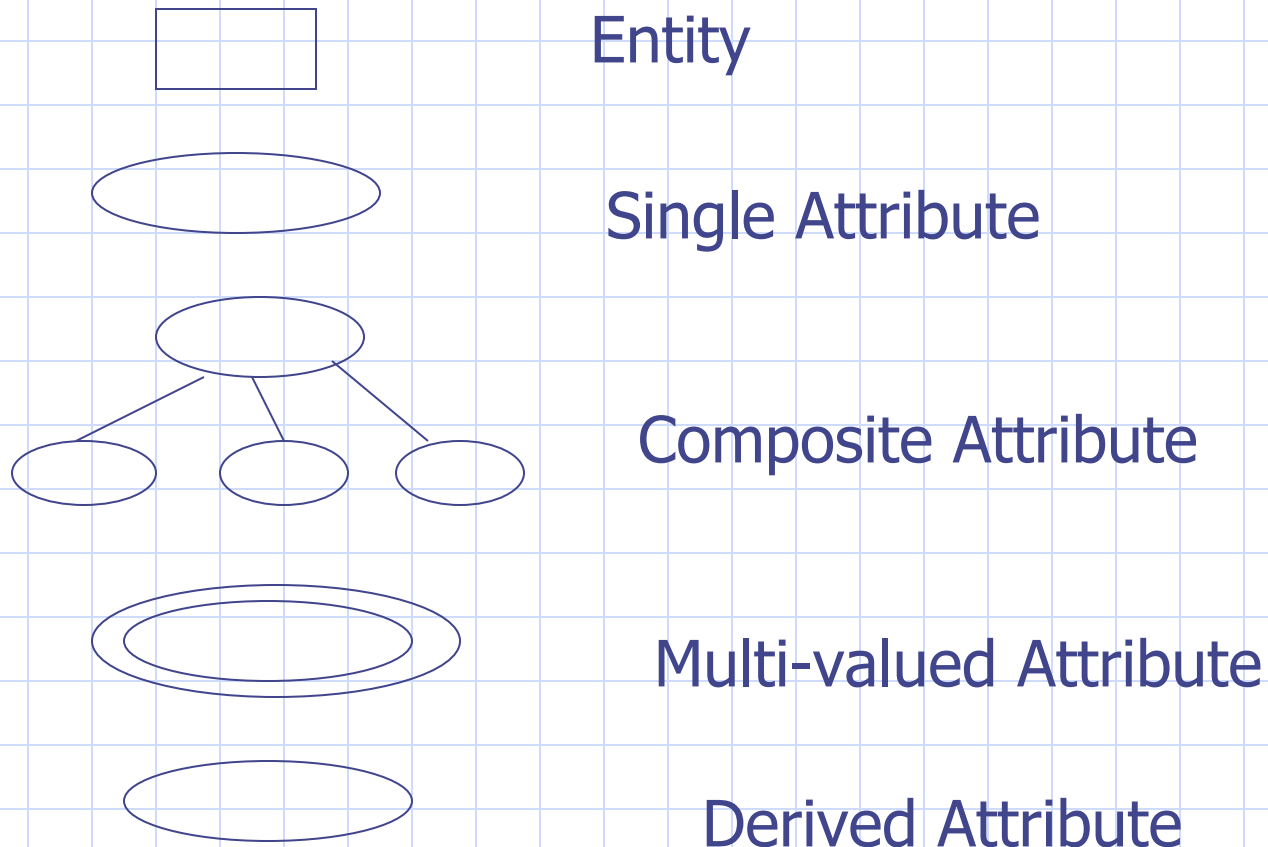
- Stored vs. Derived attribute

- Stored attribute
 - e.g. birthDate
- Derived attribute
 - . Derived from other attribute
 - . e.g. $\text{age} = \text{current date} - \text{birthDate}$
 - . Notation

Entity types and entity sets

- Entity Type
 - Defines a collection of entities that have the same attributes.
 - e.g. employee
 - describe the **schema** or **intension** for a set of entities that share the same structure.
- Entity Set
 - The collection of all entities of a particular entity type in the database at any point in time is called an entity set.
 - e.g. a set of instances of employees.
 - Also called the **extension** of the entity type.

ER Diagram For Entity and Attribute



Key

- A key is an attribute or the combination of multiple attributes that can be used to distinguish one entity instance from other entity instances in an entity type.
 - (e.g. SSN of an employee)
- Composite Key: A set of attributes as the key of an entity.
- Key must be minimal
- Notations
- Composite attributes as a key

Value Sets

- Value set (or domain of values):
- The set of values that may be assigned to the attribute for each **individual** entity
- e.g. age of employee:
value set: integer between 16 and 70
- Not displayed in ER diagram

Example

-ER diagram for entity

- A department has a unique name and a unique number. A department may have several locations.

Relationship

- Relationship Type

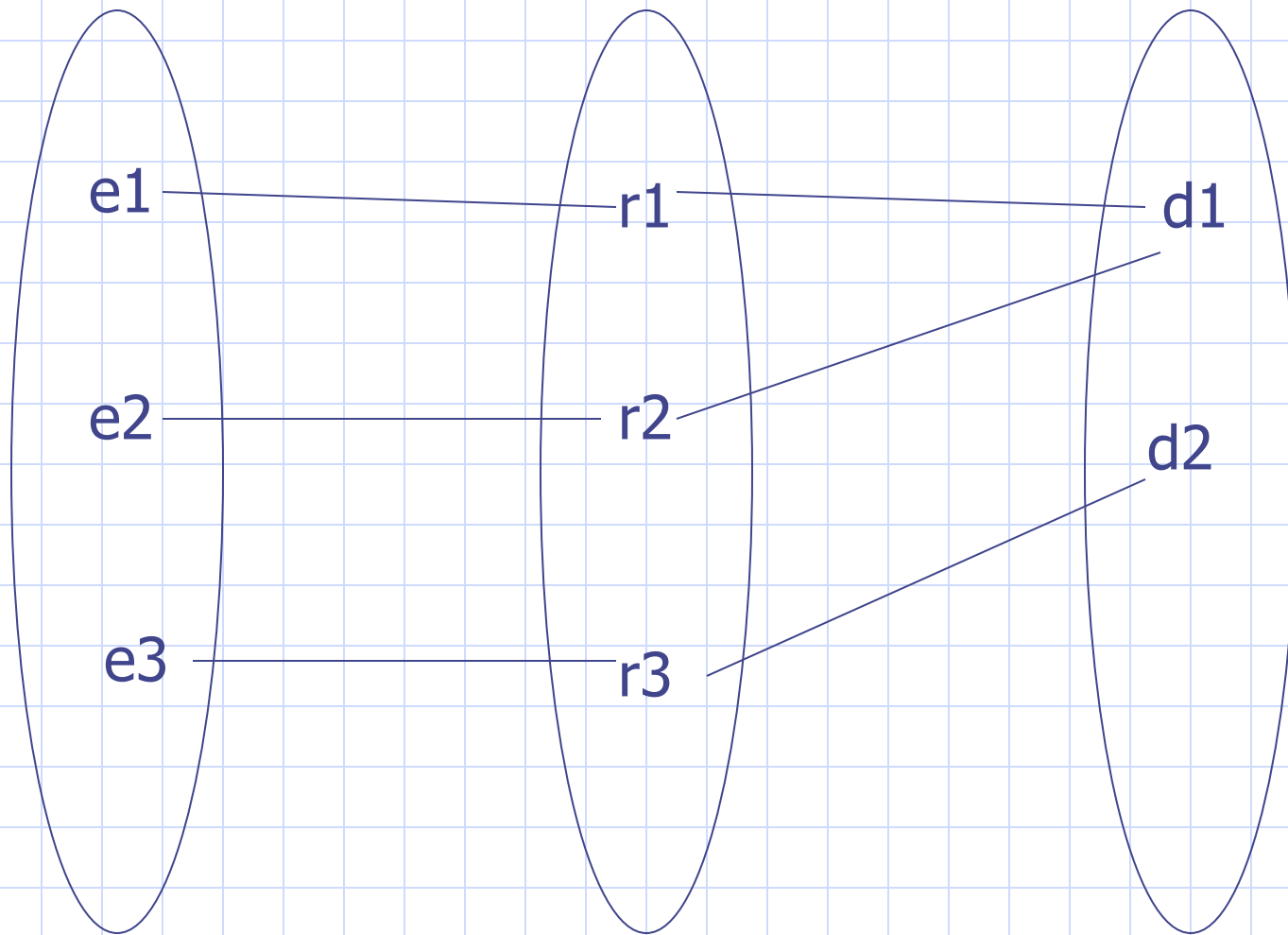
- Defines a set of associations among entity types
- e.g. Employees work for a department.



- Relationship Instance

- Instance of a relationship type that associates with entity instances.

Example of Relationship Instance



Math presentation

- Relationship R
- Relationship instance r_i
 - r_i associate n individual entities (e_1, e_2, \dots, e_n) , where e_j is a member of entity type E_j .
 - Each of the individual entities e_1, e_2, \dots, e_n is said to participate the in the relationship instance $r_i = (e_1, e_2, \dots, e_n)$

Relationship role name

- Each entity type that participates in a relationship type plays a particular **role**.
- **Role name**: signify the rule that a participating entity from the entity type plays in each relationship instance.
- e.g. employee plays the role of worker
department plays the role of employer.

Structure Constraint



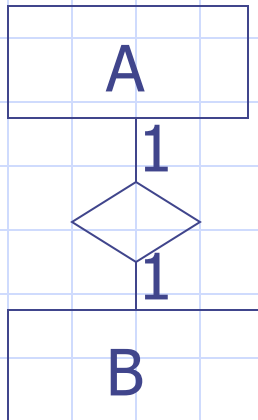
- Cardinality Ratios
- Participation Constraints

Cardinality Ratios for Binary Relationship

- Specify the the number of relationship instances that an entity can participate in.
- Possible cardinality ratios
 - 1:1 (one to one)
 - 1:N (one to many)
 - N:1 (many to one)
 - M:N (many to many)

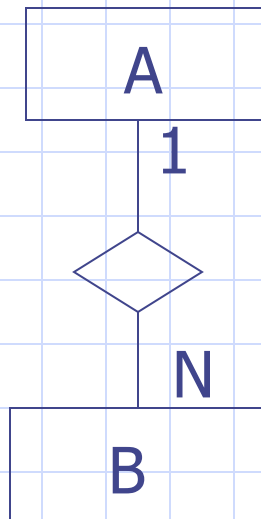
Cardinality Ratio 1:1

- One instance of A can be associated with only one instance of B.



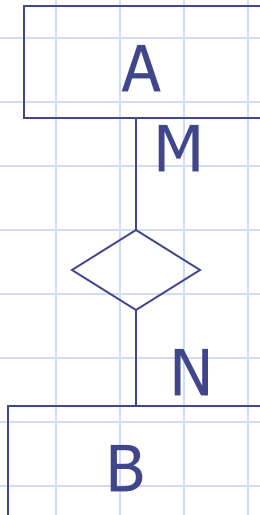
Cardinality Ratio 1:N

- One instance of A can be associated with any number of instances of B
- One instance of B can be associate with only one instance of A



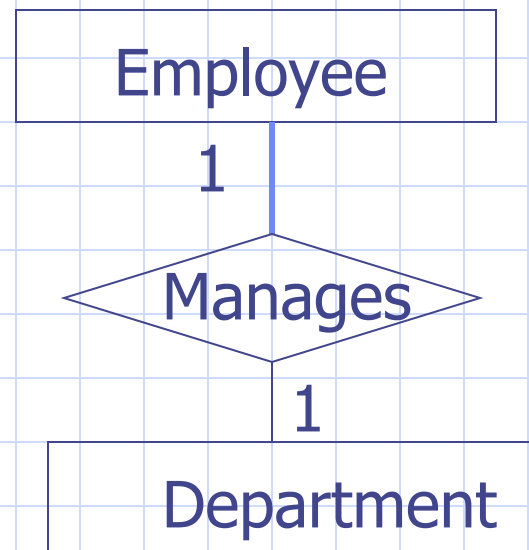
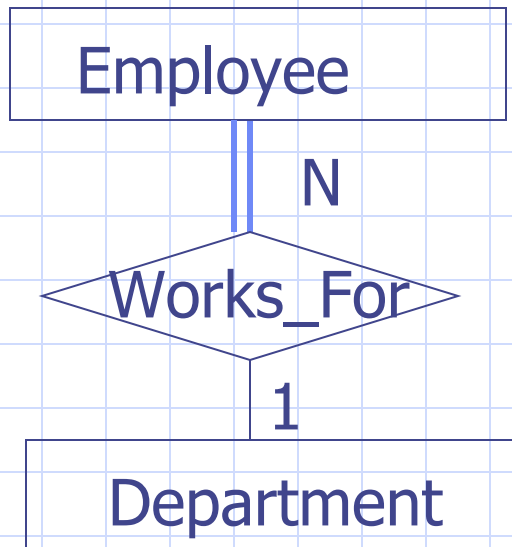
Cardinality Ratio M:N

- One instance of A can be associated with any number of instances of B
- One instance of B can be associated with any number of instances of A



Participation Constraints

- Total Participation (Existence dependency)
 - Any employee *must* work for one department.
- Partial Participation
 - Some of the employee entities manage department entities, but not necessary all.



Weak Entity

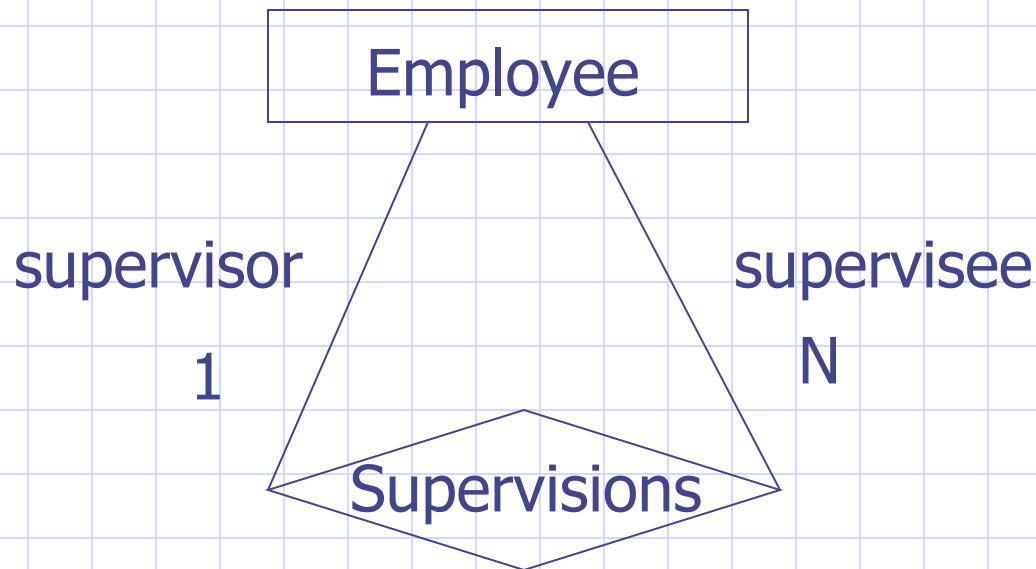
- Figure
- Does not have key attributes of its own.
- Has total participation constraints
- **Partial Key**: Unique identifier of a weak entity that can be used to distinguished from other weak entities related to the same owner entity

Attributes of relationship types

- An attribute conceptually belongs to the relationship
- M:N
 - Attributes may be determined by the combination of participating entities in a relationship instance, **not by any single entity**
- 1:1
 - A relationship attribute can be migrated to one of the participating entity types
- 1:M
 - A relationship attribute can be migrated only to the entity type on the N-side.
- 1:1 and 1:M: determined subjectively by the schema designer

Recursive Relationship

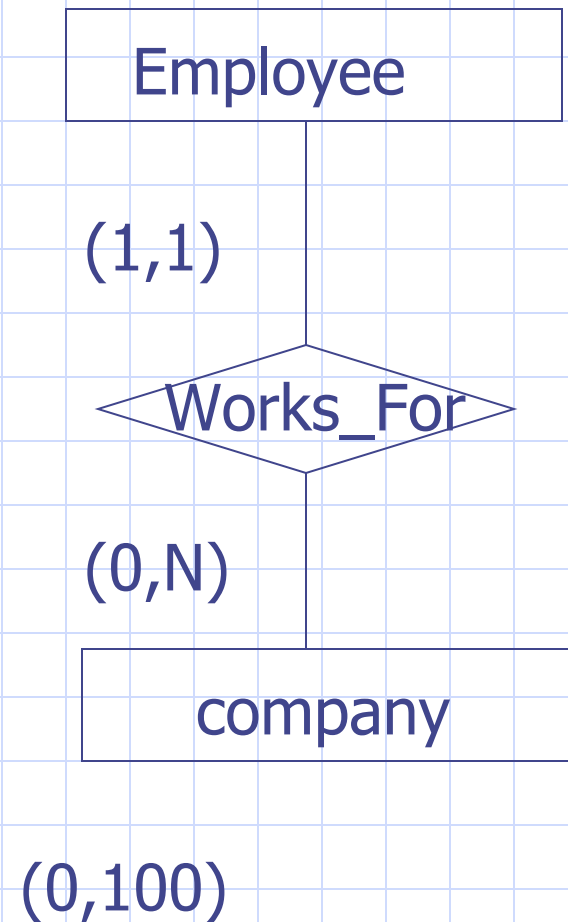
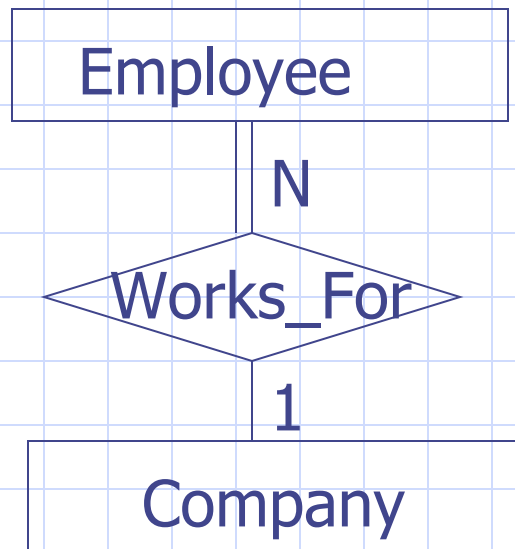
The Same entity type participates more than once in a relationship type in different roles.



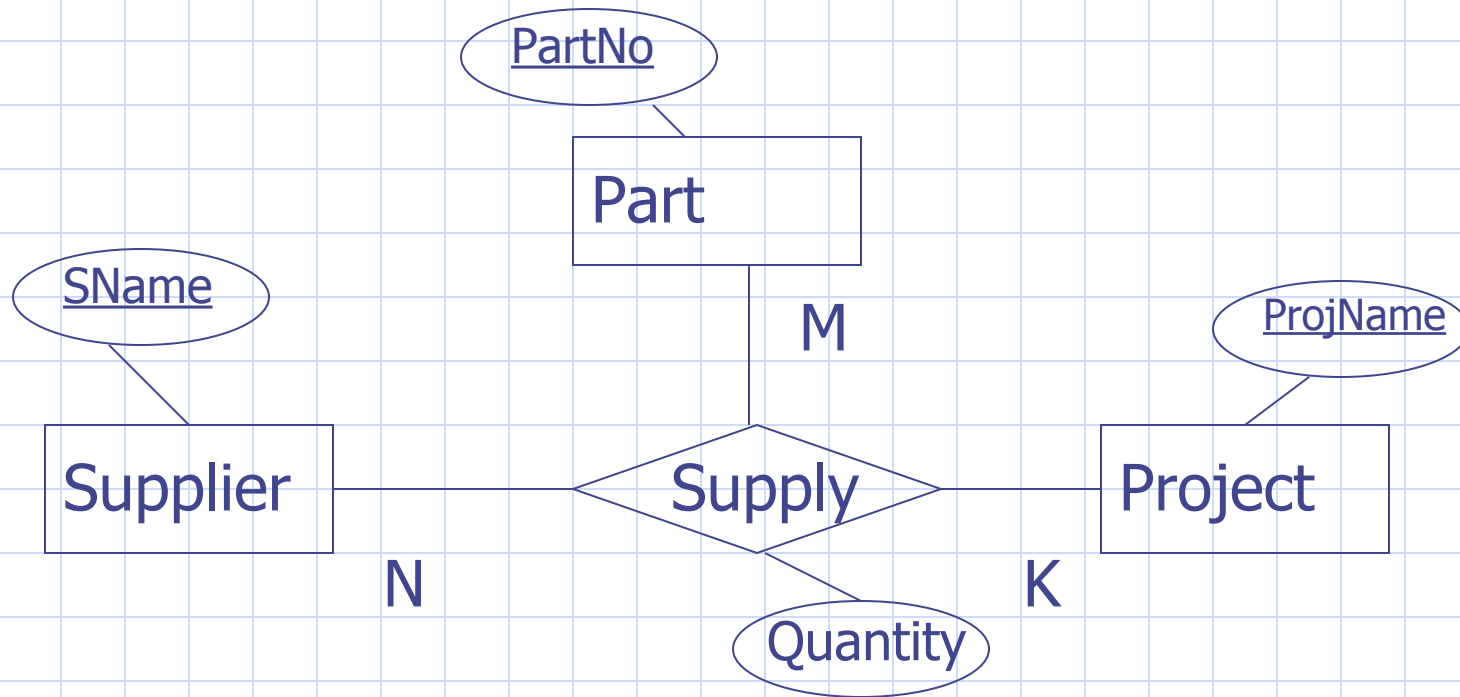
Min/Max Notation

- A more precise way to present structure constraints.
- An entity instance e of an entity type E must participate in at least **min** and at most **max** relationship instances in R at all times.
- $\text{Max} \geq \text{Min} \geq 0$
- $\text{Max} \geq 1$
- $\text{Min} = 0$: partial participation
- $\text{Min} > 0$: total participation

Example of Min/Max Notation



Non-Binary Relationship



A ternary relationship

