Lecture 7:
E-R Diagram

Database Systems

In the last lecture

- Join
  - ✓ Used to combine rows from two or more tables based on a related column between them
- Nested query
  - ✓ SELECT statement included in the WHERE clause of the outer query again in the form SELECT ... FROM ... WHERE
- The result of a nested query can return
  - ✓ A scalar value (single value)
  - ✓ A relation with one attribute
  - ✓ A relation with multiple attributes

Part 1

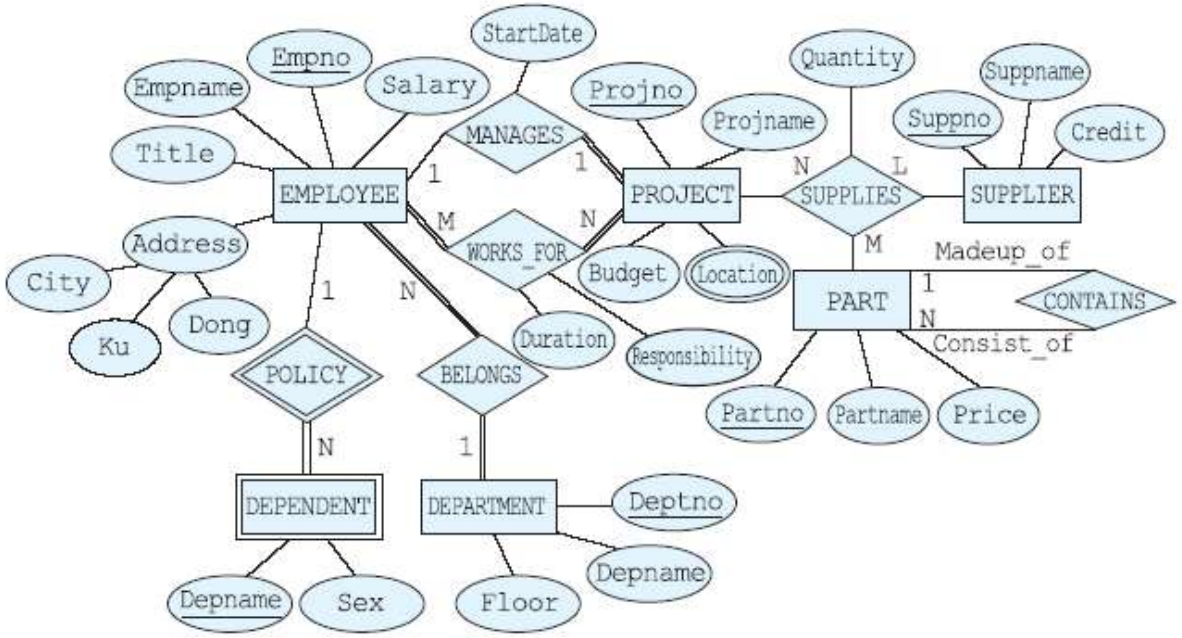
WHAT IS E-R DIAGRAM?

I. E-R Diagram

- Entity-Relationship Diagram (E-R Diagram)

Design for DB

  - ✓ Expressing the real world as entities, attributes, and relationships between entities



[그림 5.42] 회사의 ER 스키마 다이어그램

I. E-R Diagram

- E-R diagram
  - ✓ To facilitate database design, proposed by P.P. Chen in 1976
    - ✓ Currently, Enhanced Entity Relationship (EER) models are widely used in the database design process.
  - ✓ ER diagrams are transformable into relational tables which allows you to build databases quickly
  - ✓ Provide a preview of how all your tables should connect, what fields are going to be on each table
  - ✓ Easy to learn with little effort and easy to understand even if you are not an expert

Part 2

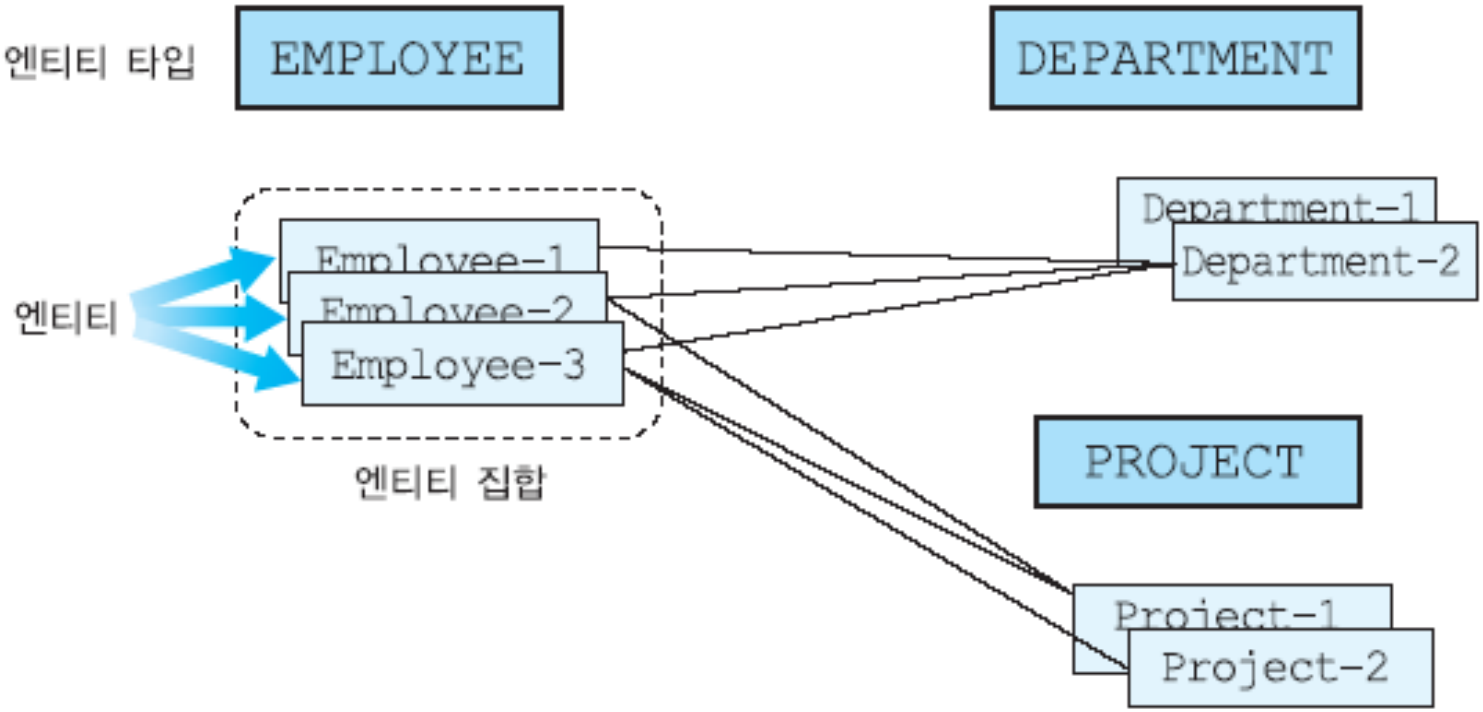
E-R DIAGRAM COMPONENTS

2. E-R Diagram Components

- Entity
  - ✓ An entity is an object about which you want to store information
  - ✓ A set of entities are entity type
  - ✓ In E-R diagrams, entity types are represented as rectangles

[그림 5.2] 엔티티의 예

2. E-R Diagram Components



[그림 5.3] 엔티티, 엔티티 타입, 엔티티 집합

2. E-R Diagram Components

- Strong entity type
  - ✓ Strong entity type (regular entity types) can uniquely identify the entity using its own key attribute

primary key가 될 수 없음

- Weak entity type
  - ✓ Weak entity is dependent on strong entity
    - ✓ Cannot exists without a corresponding strong entity
    - ✓ Weak entity type does not have enough attributes to form a key
  - ✓ Marked as Double Line Rectangle in E-R Diagram

2. E-R Diagram Components

- Attributes

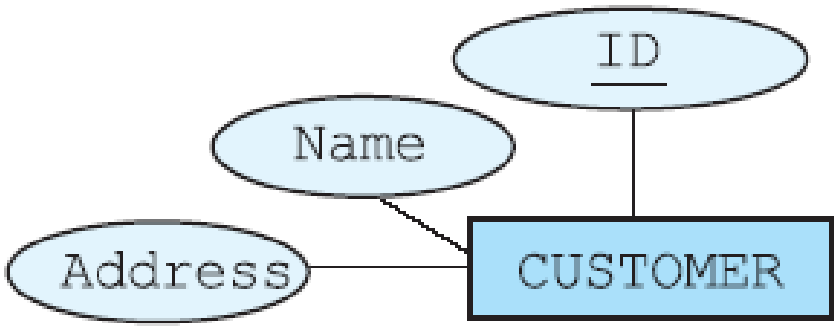
  - ✓ One entity is described as a set of associated attributes
    - ✓ Example: an employee entity has attributes such as Employee Number, Name, Title, and Salary

  - ✓ A key attribute is an attribute or collection of attributes that uniquely identifies each entity within an entity type.
    - ✓ Attributes belonging to primary key in ER diagrams are underlined

  - ✓ Attributes are represented as Oval in E-R diagram and connected to entity types by solid lines

2. E-R Diagram Components

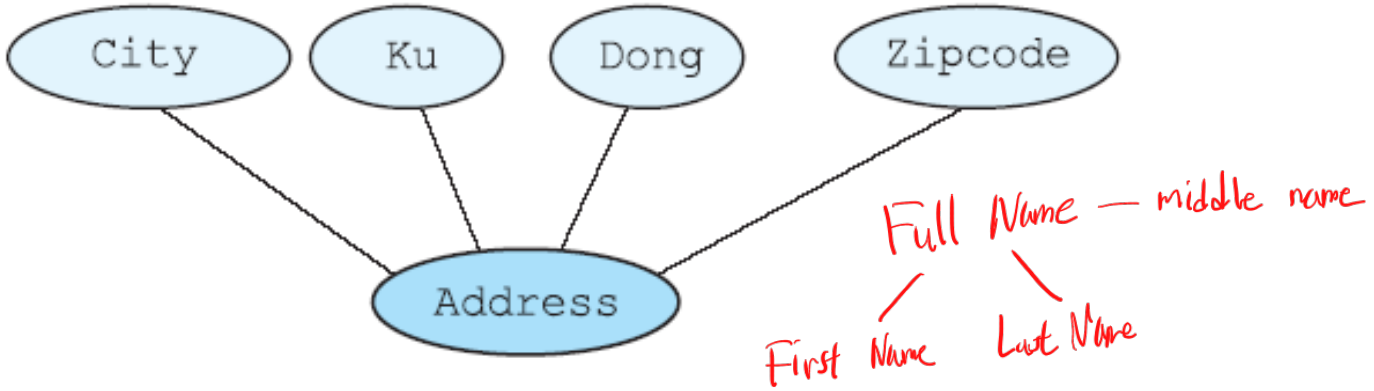
- Simple attribute
  - ✓ Most attributes in ER diagrams are simple attributes
  - ✓ Shown as solid oval in ER diagram



[그림 5.4] 단순 애트리뷰트

2. E-R Diagram Components

- Composite attribute
  - ✓ An attribute consisting of two or more attributes
  - ✓ A collection of closely related attributes of the same entity type or relationship type



[그림 5.5] 복합 애트리뷰트

2. E-R Diagram Components

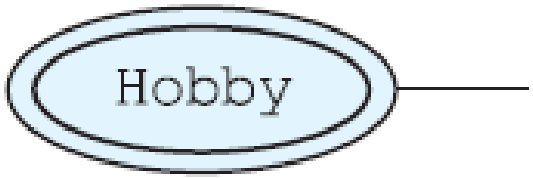
- Single-valued attribute

  simple attr

  - ✓ Attribute with exactly one value for each entity
  - ✓ Same representation as a simple attribute in an E-R diagram
    - ✓ Example: The employee number attribute of an employee is a single-valued attribute because no employee has more than one employee number.
  - ✓ Most attributes in an E-R diagram are single valued attributes.

2. E-R Diagram Components

- Multi-valued attribute
  - ✓ An attribute that can have multiple values for each entity
  - ✓ Expressed as double line ellipse in E-R diagram



[그림 5.6] 다치 애트리뷰트

2. E-R Diagram Components

- Stored attribute
  - ✓ An attribute which are physically stored in the database
  - ✓ Same representation as a simple attribute in an E-R diagram
  - ✓ Most attributes in an E-R diagram are stored attributes.
  - ✓ Example:
    - ✓ Assume a table called as student. There are attributes such as student_id, student_name, student_email. We cannot derive value of these attribute using other attributes.

2. E-R Diagram Components

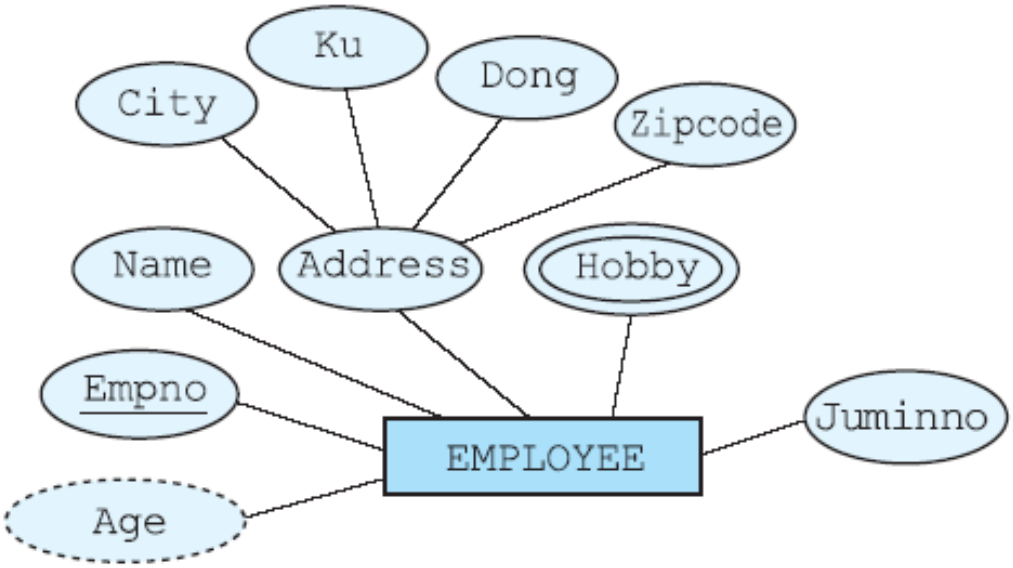
- Derived attribute
  - ✓ Attribute obtained from the value of the other attribute
  - ✓ Represented by dotted ellipse in ER diagram

[그림 5.7] 유도된 애트리뷰트

2. E-R Diagram Components

예 : 애트리뷰트들의 유형

아래 그림 5.8에서 단순 애트리뷰트, 복합 애트리뷰트, 단일 값 애트리뷰트, 다치 애트리뷰트, 키 애트리뷰트, 저장된 애트리뷰트, 유도된 애트리뷰트들을 구분하라.



[그림 5.8] 여러 가지 애트리뷰트의 예

2. E-R Diagram Components

- Relationships and Relationship Types
  - ✓ Relationship is a connection between entities that can be thought of as a mapping between two or more entity types.
  - ✓ Verbs are often represented as relations in the E-R diagram in the requirements specification.
  - ✓ Marked with diamonds in the E-R diagram

2. E-R Diagram Components

- Relationships and Relationship Types

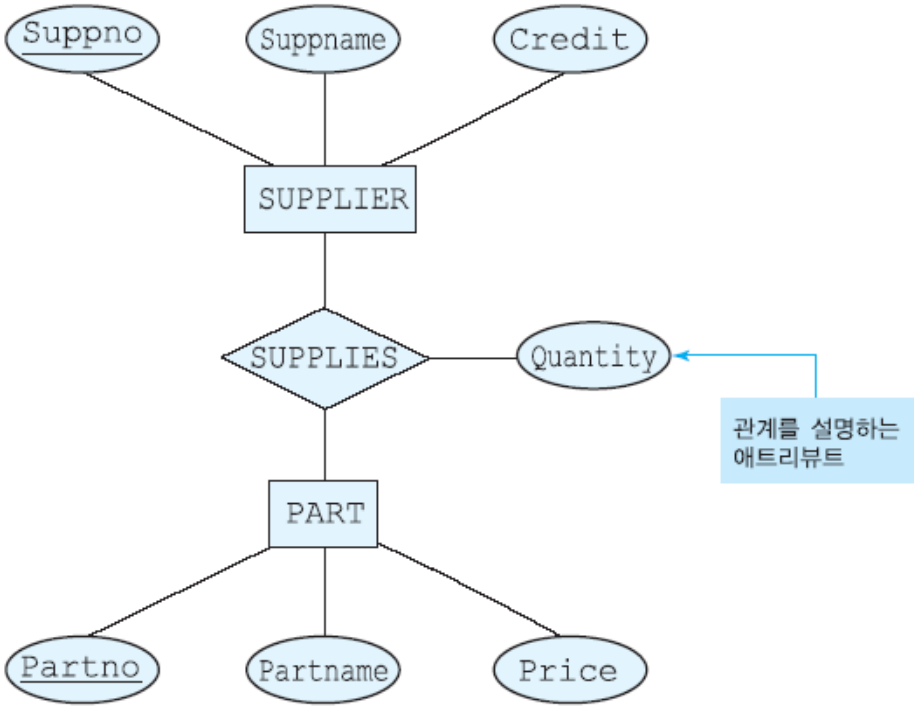
[그림 5.10] 관계 타입 WORKS_FOR

〈표 5.2〉 엔티티와 엔티티 간의 관계의 예

엔티티	관계	엔티티
사원(employee)	근무한다(works for)	부서(department)
공급자(supplier)	공급한다(supplies)	부품(part)
학생(student)	수강한다(enrolls)	과목(course)

2. E-R Diagram Components

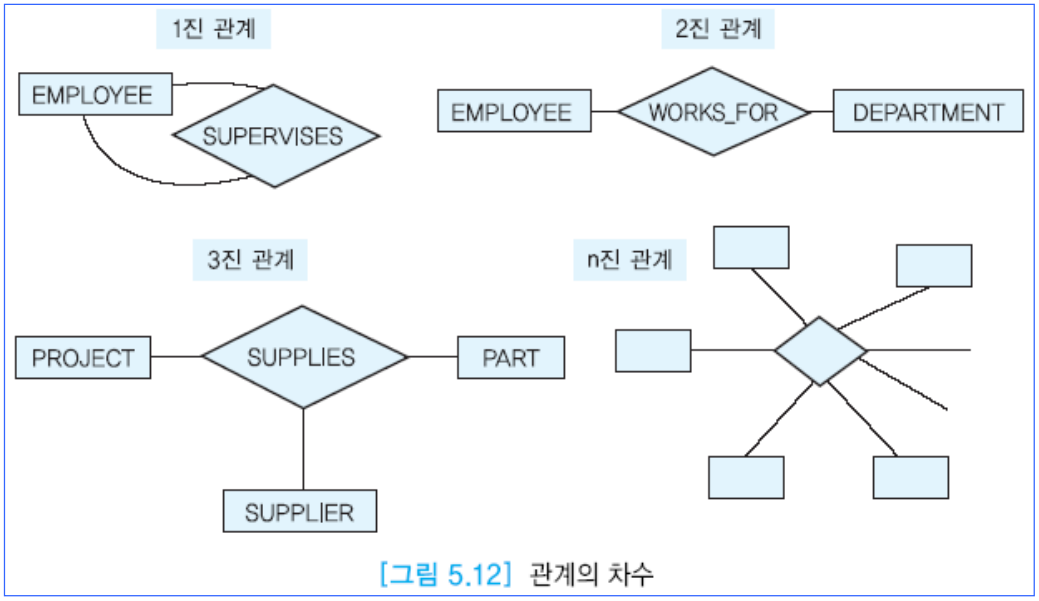
- Attribute of the relationship
  - ✓ Relationship types can have attributes that describe the characteristics of the relationship
  - ✓ Relationship type does not have a key attribute



[그림 5.11] 관계가 갖는 애트리뷰트

2. E-R Diagram Components

- Degree
  - ✓ The number of entity types connected in a relationship
  - ✓ The most common relationship in the real world is a binary relationship that connects two entity types.



[그림 5.12] 관계의 차수

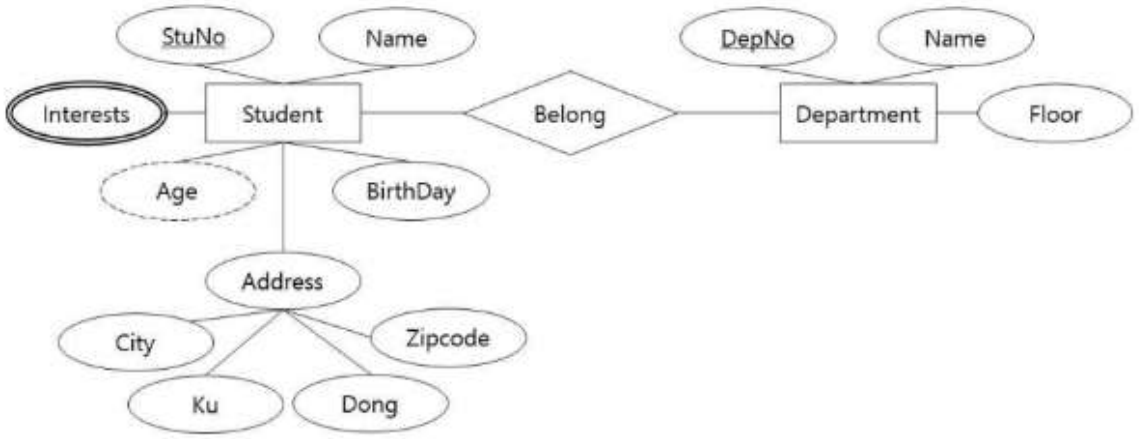
Quiz

- ✓ Create your own E-R Diagram that contains two entity types and connect them with relationship

- ✓ For your entity types, include the following attributes:
  - ✓ Primary key attribute
  - ✓ Simple attribute
  - ✓ Composite attribute
  - ✓ Multi-valued attribute
  - ✓ Derived attribute
  - ✓ Relationship attribute

2. E-R Diagram Components

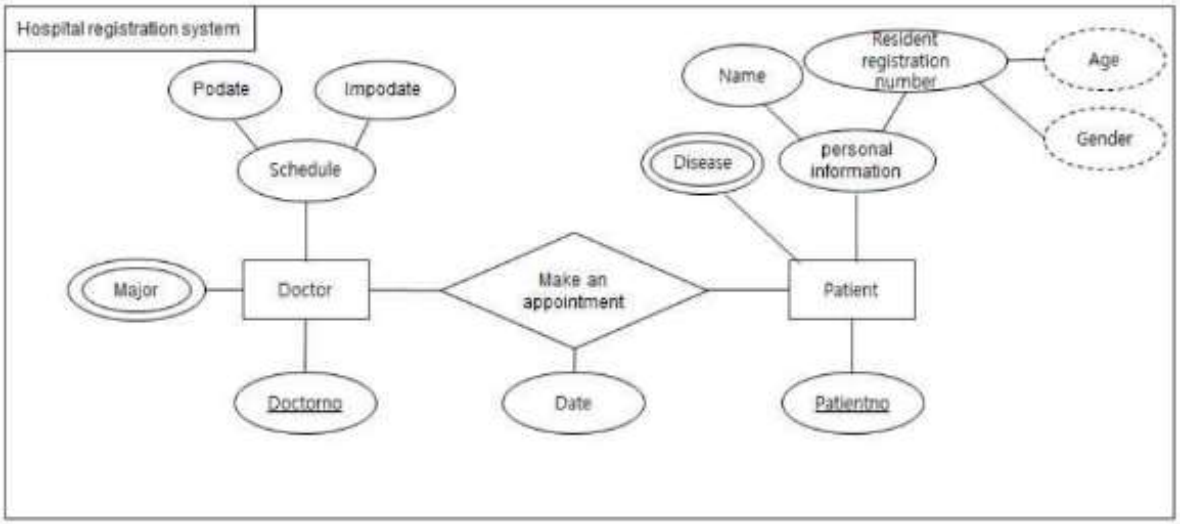
- Examples



- Primary Key -> CORRECT
- Composite Attribute -> CORRECT
- Multi-valued Attribute -> CORRECT
- Derived Attributes -> CORRECT
- Naming -> CORRECT, but incorrect GRAMMAR

2. E-R Diagram Components

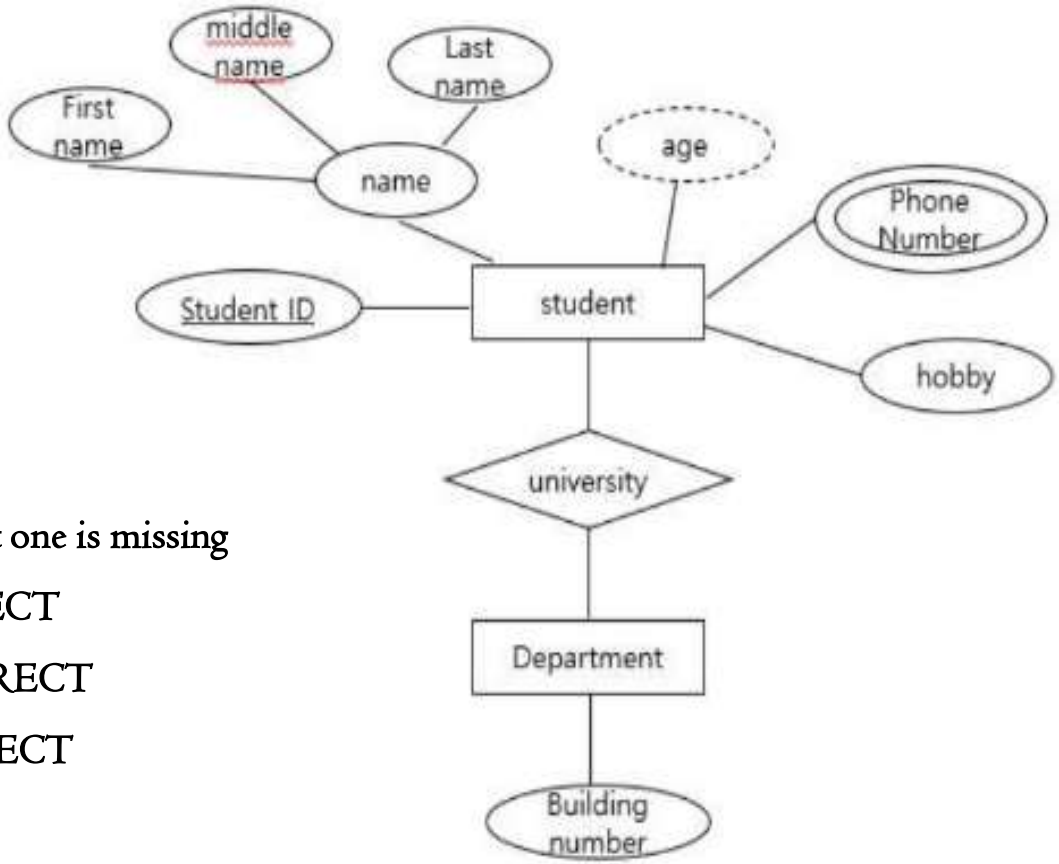
- Examples



- Primary Key -> CORRECT
- Composite Attribute -> CORRECT, but do not use nested composite attributes
- Multi-valued Attribute -> CORRECT
- Derived Attributes -> CORRECT, but connect them to entity type
- Naming -> CORRECT, but incorrect GRAMMAR

2. E-R Diagram Components

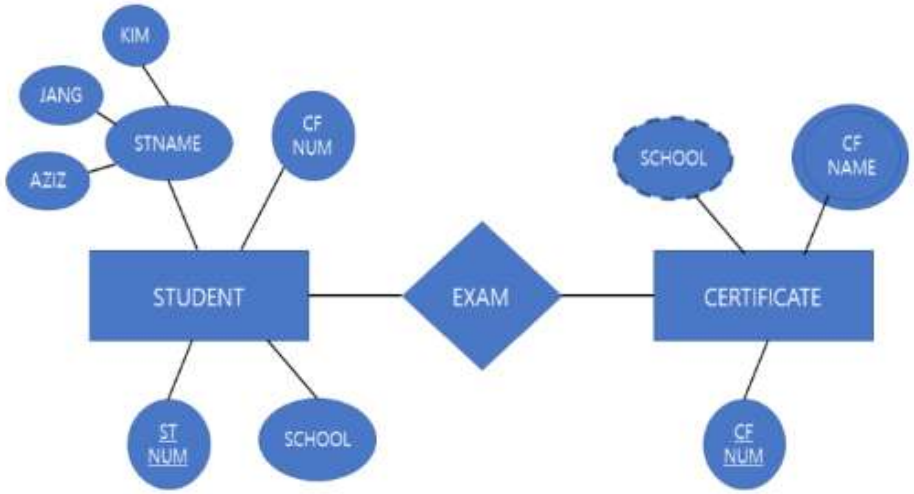
- Examples



- Primary Key -> CORRECT, but one is missing
- Composite Attribute -> CORRECT
- Multi-valued Attribute -> CORRECT
- Derived Attributes -> INCORRECT
- Naming -> INCORRECT

2. E-R Diagram Components

- Examples



No FK

- Primary Key -> CORRECT
- Composite Attribute -> INCORRECT
- Multi-valued Attribute -> STRANGE
- Derived Attributes -> STRANGE
- Naming -> INCORRECT

Part 3

CARDINALITY

3. Cardinality

- Cardinality
  - ✓ Cardinality represents the number of relationships an entity can participate in
  - ✓ Relationships are often divided into 1:1, 1:N, M:N
    - ✓ Cardinality ratio
  - ✓ Information on cardinality indicates over trunk of relationship

3. Cardinality

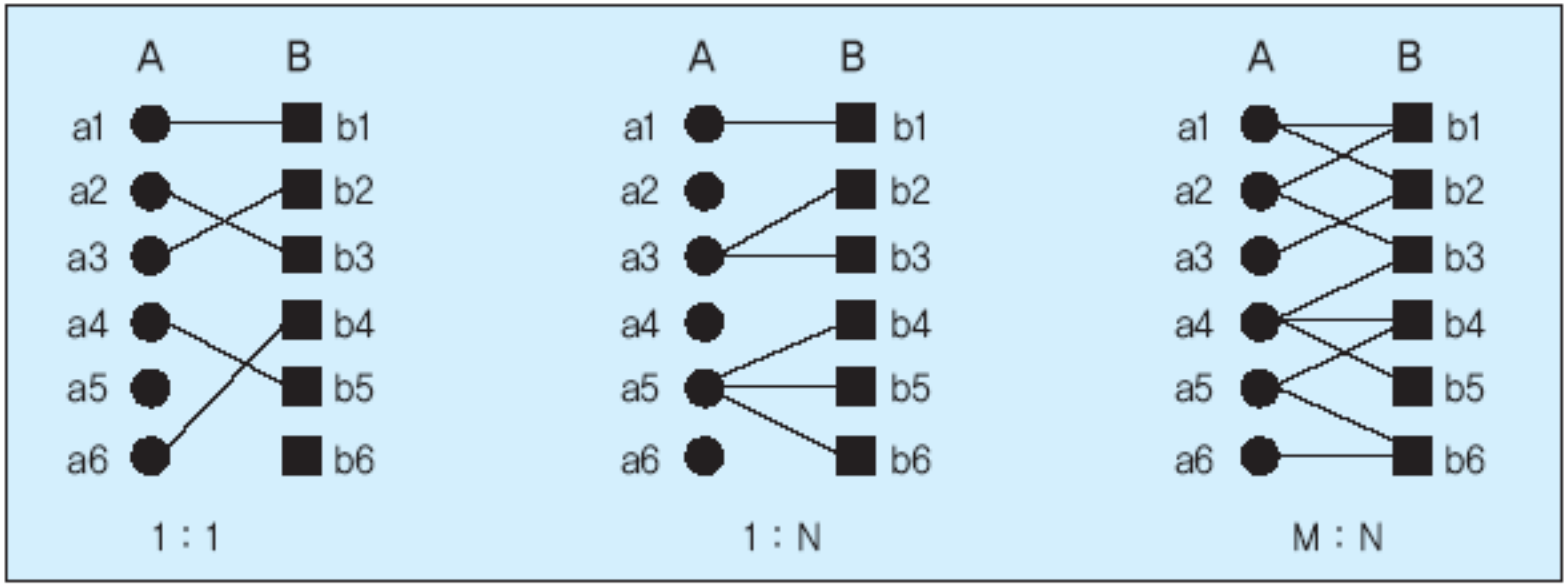
- I:I relation
  - ✓ If each entity in A is correctly associated with one entity in B, and each entity in B is correctly associated with one entity in A

- I:N relation
  - ✓ If each entity in A is associated with any number of entities in B, and each entity in B is correctly associated with one entity in A

- M:M relation
  - ✓ Any number of entities belonging to one entity type are associated with any number of entities belonging to another entity type

3. Cardinality

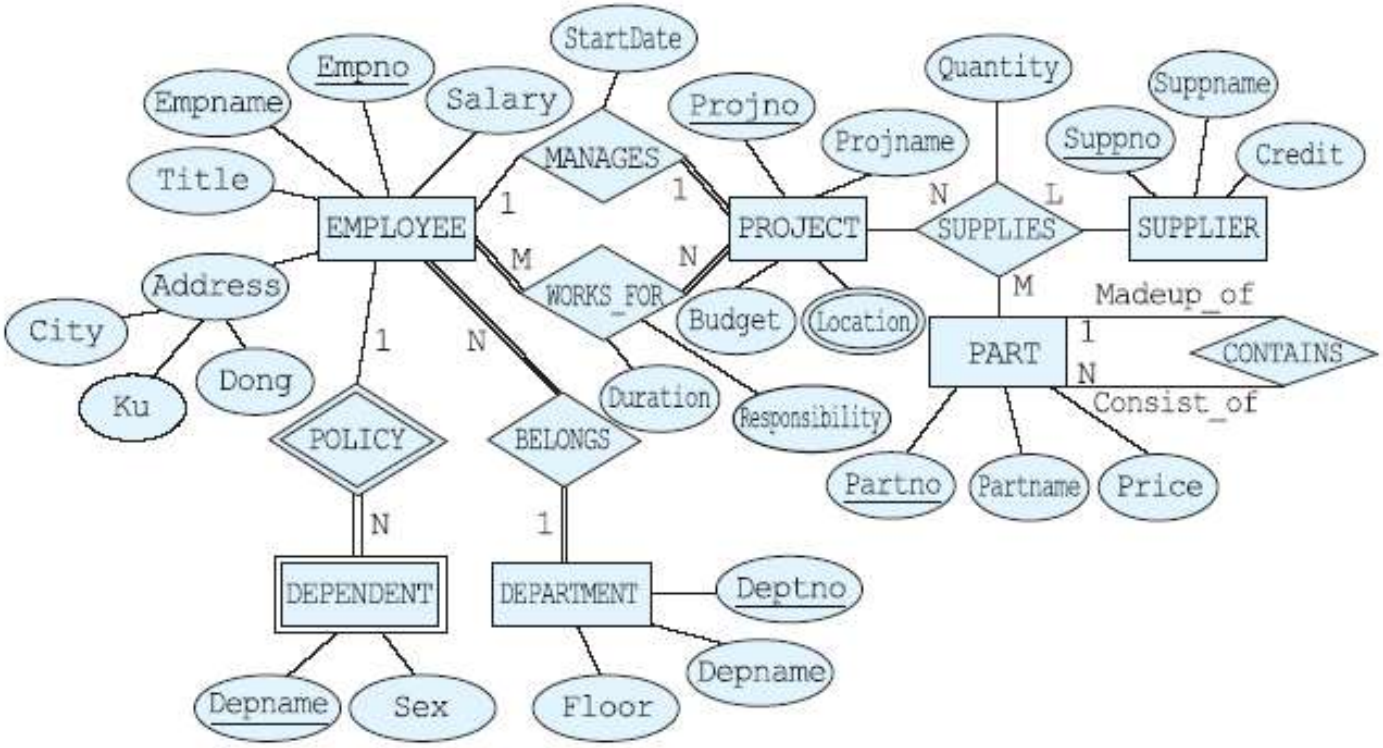
- Cardinality ratios



[그림 5.14] 카디날리티 비율

3. Cardinality

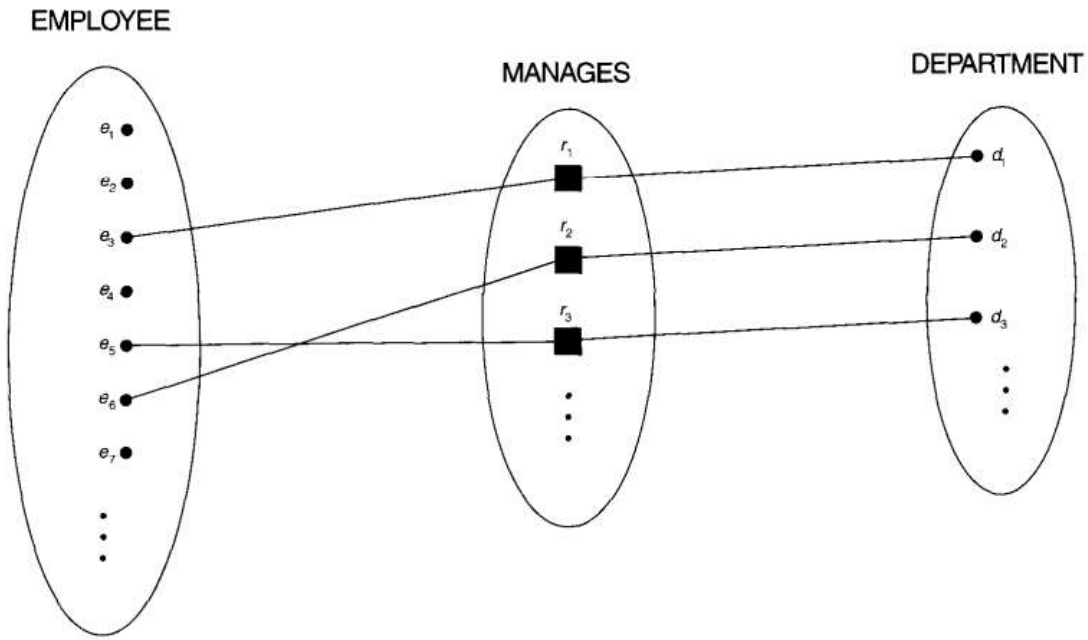
- Example



[그림 5.42] 회사의 ER 스키마 다이어그램

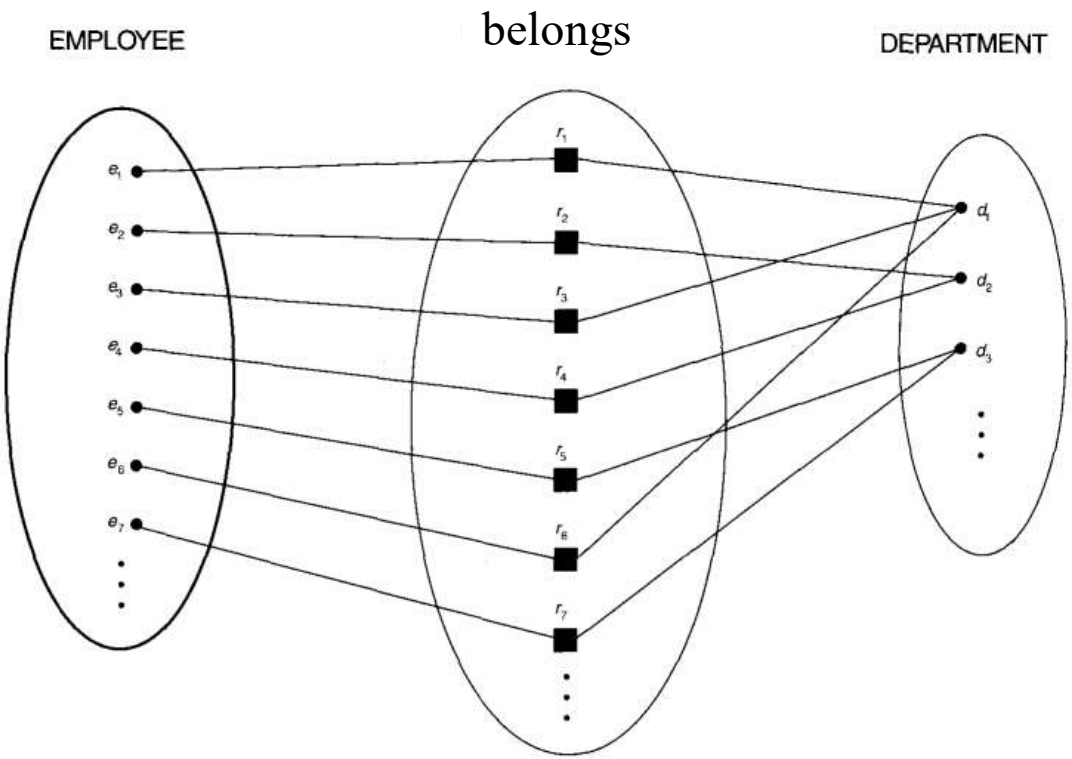
3. Cardinality

- Example of 1:1 relationship
  - One employee can manage only one department and one department can be managed by only one person (i.e., employee)



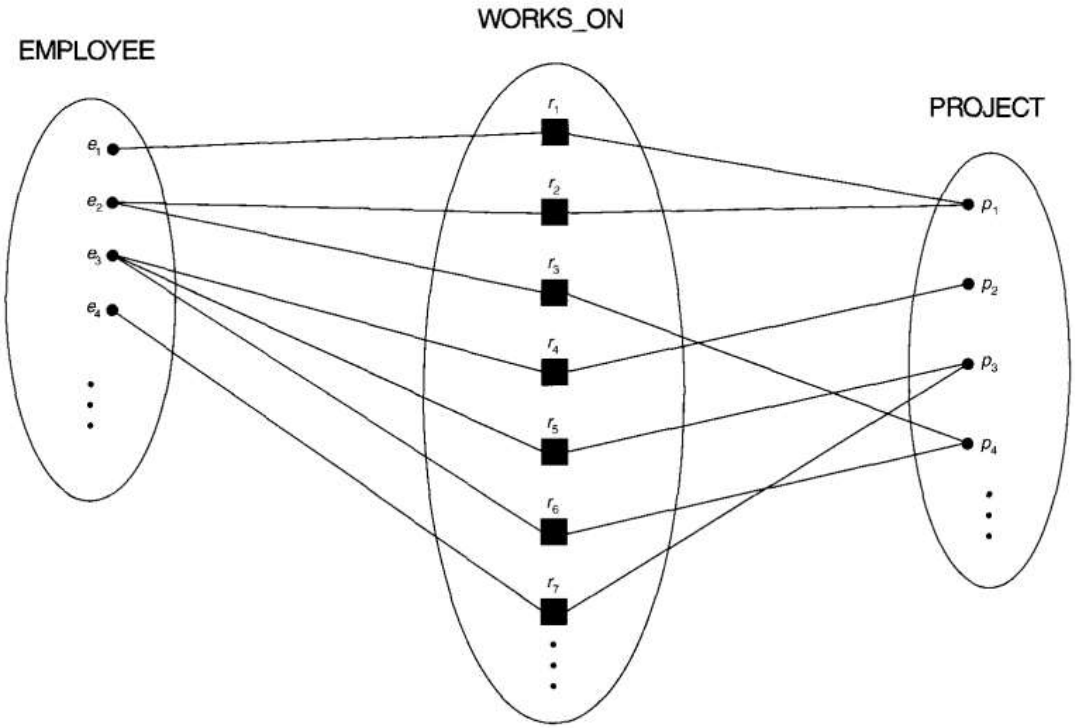
3. Cardinality

- Example of 1:M relationship
  - One employee can belong to only one department but a department can have many employees



3. Cardinality

- Example of M:M relationship
  - One employee can work on several projects and a project can have many employees



3. Cardinality

- Example of 1:1 relationship
  - A person has only one passport and a passport is given to one person

- Example of 1:M relationship
  - A customer can place many orders but an order cannot be placed by many customers

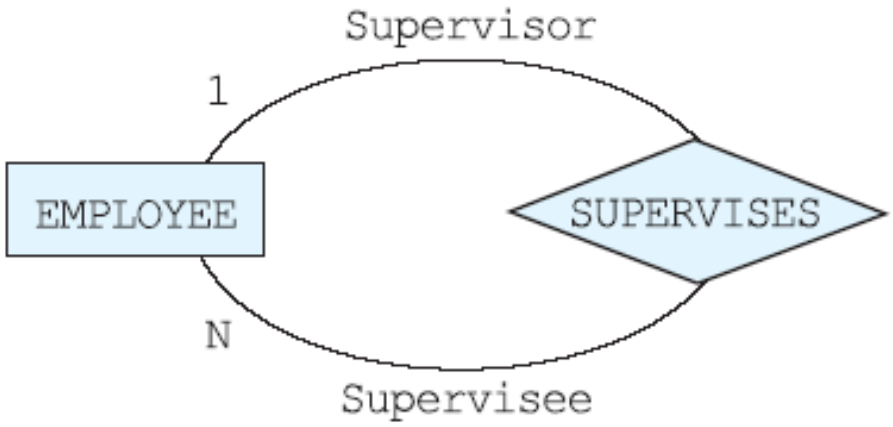
3. Cardinality

- Example of M:M relationship
  - A student can be assigned to many projects and a project can be assigned to many students

3. Cardinality

- Role
  - ✓ Used to clarify the meaning of the relationship type
  - ✓ In particular, if an entity type appears multiple times in a relationship type, the role must be indicated.
  - ✓ Display above edges of relationship type

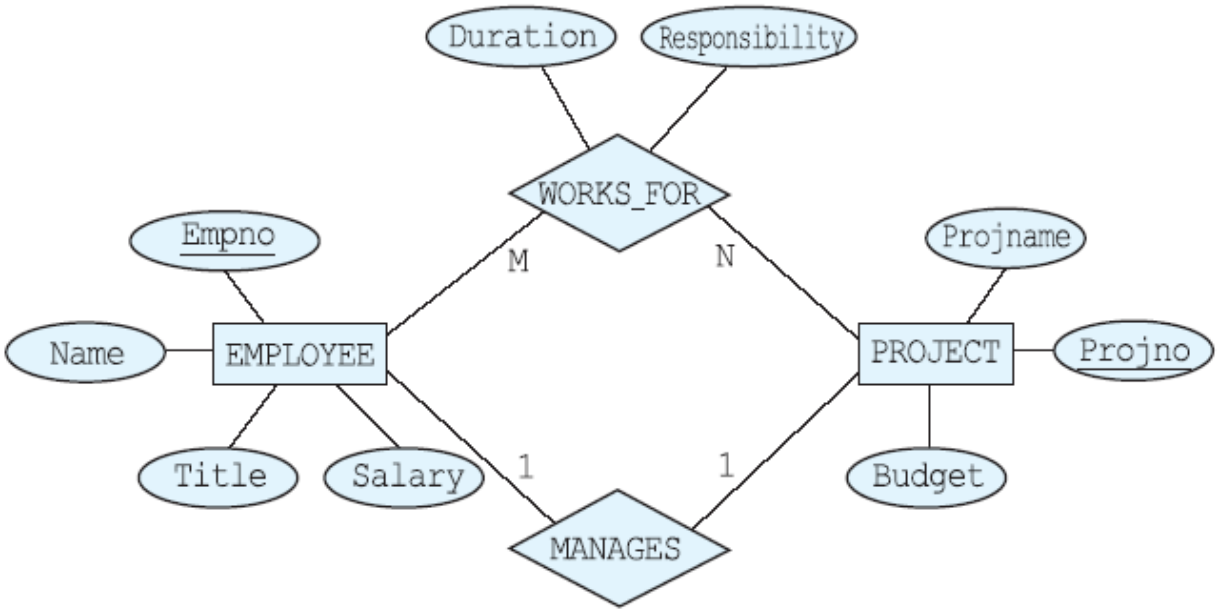
role



[그림 5.18] 역할

3. Cardinality

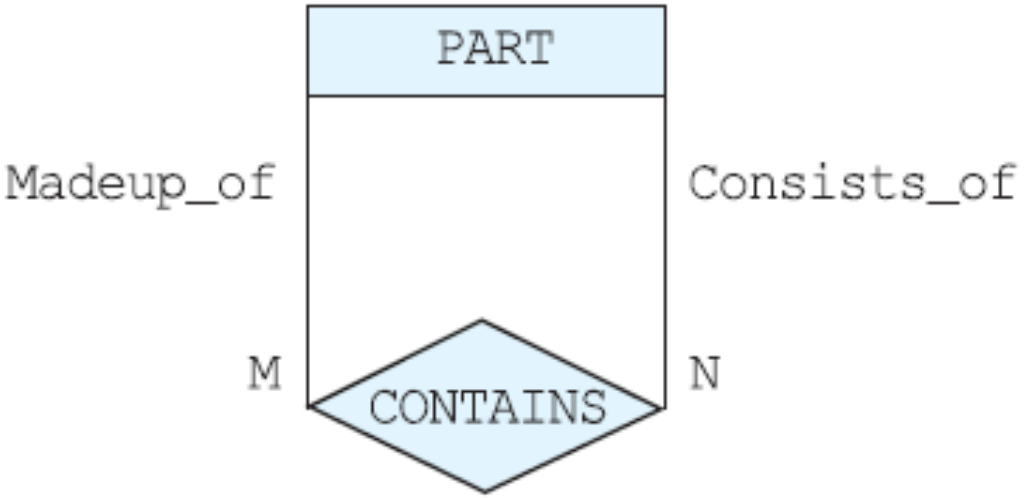
- Multiple relations
  - ✓ More than one relation type can exist between two entity types



[그림 5.20] 다중 관계

3. Cardinality

- Circular relation
  - ✓ An entity type participates more than once in the same relational type



[그림 5.21] 순환적 관계

Part 4

PARTICIPATION

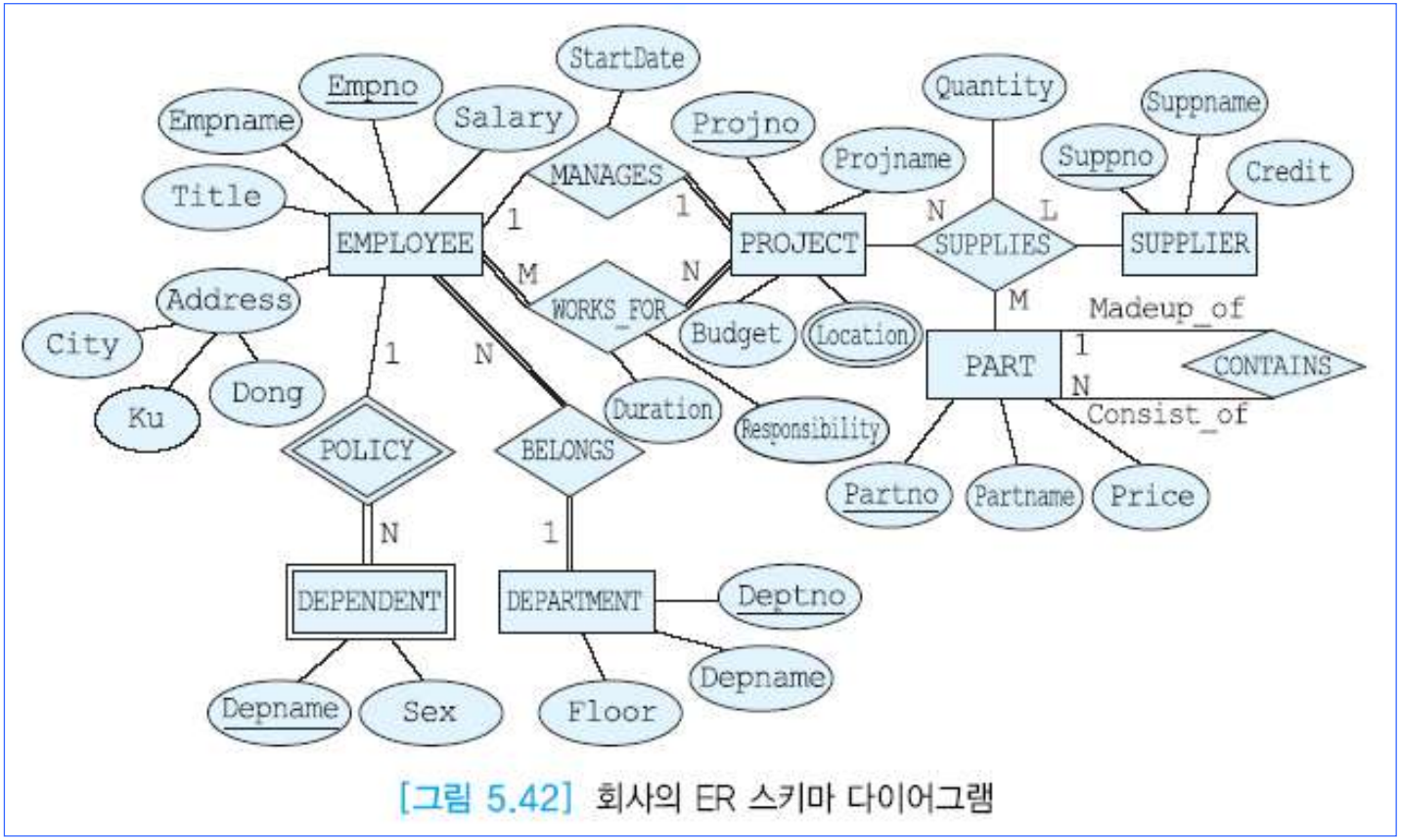
4. Participation

- Full and partial participation
  - ✓ Full participation
    - ✓ In a relationship all entities of entity type are involved in the relationship.
  - ✓ Partial participation
    - ✓ Only some entities of entity type participate in a relationship
  - ✓ Full participation is represented by double solid lines in the ER diagram

[그림 5.19] 전체 참여와 부분 참여

4. Participation

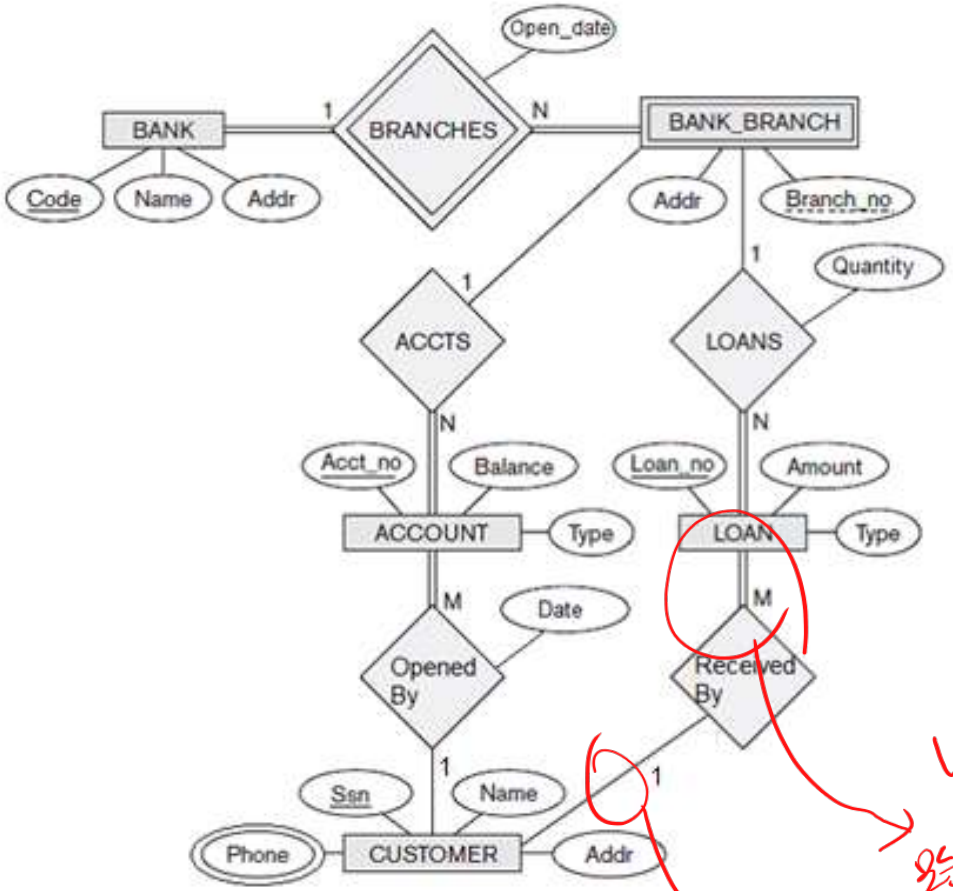
- Example



[그림 5.42] 회사의 ER 스키마 다이어그램

Summary

- Example



Questions?

SEE YOU NEXT TIME!