CO226: Database Systems

(E)ER to Relational Mapping

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(E)ER to Relational Mapping

- Steps of the ER-to-Relational Mapping Algorithm
  1. Mapping of Regular Entity Types
  2. Mapping of Weak Entity Types
  3. Mapping of Binary 1:1 Relation Types
  4. Mapping of Binary 1:N Relationship Types.
  5. Mapping of Binary M:N Relationship Types.
  6. Mapping of Multivalued attributes.
  7. Mapping of N-ary Relationship Types.
  8. Options for Mapping Specialization or Generalization.
  9. Mapping of Union Types (Categories).

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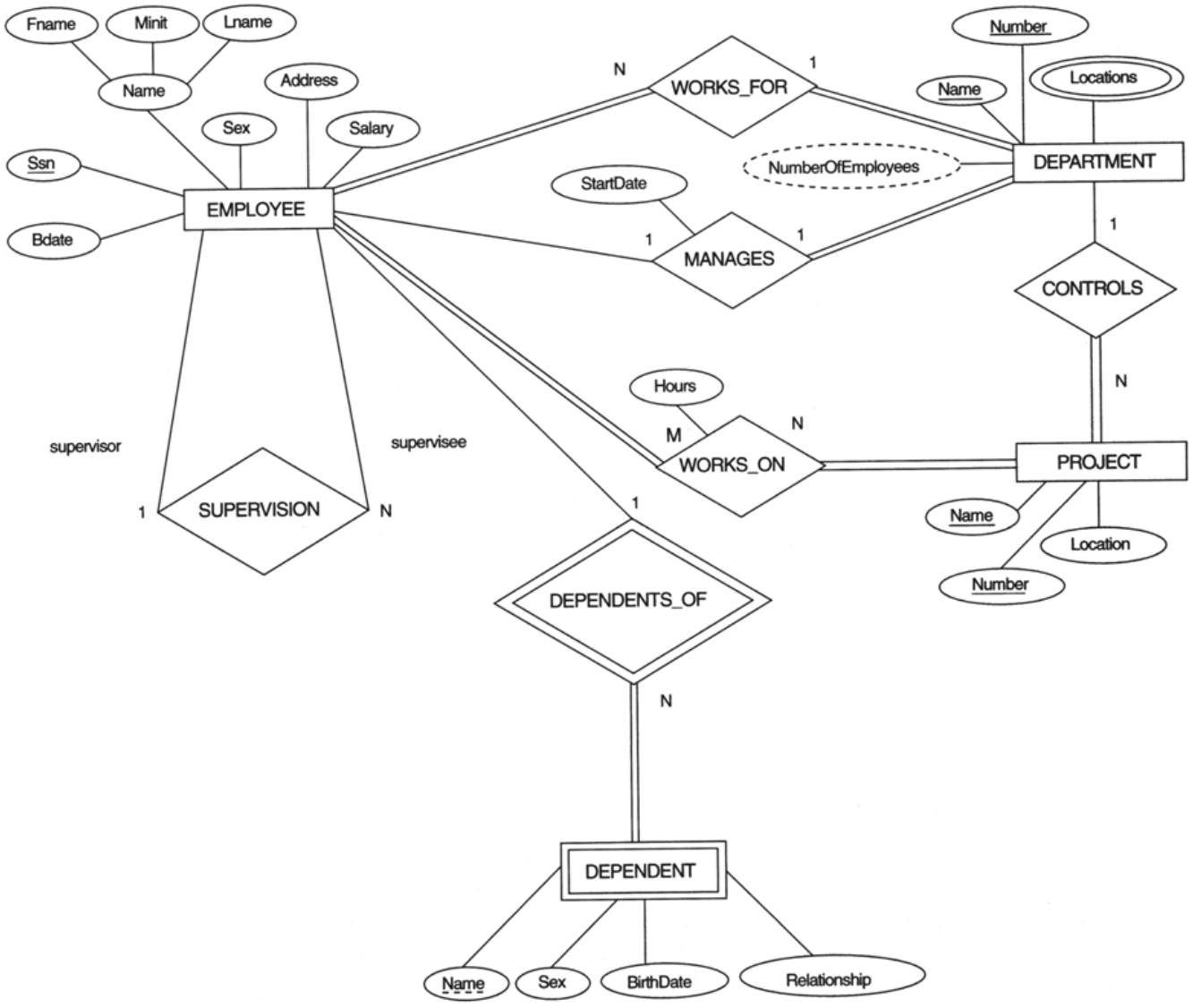
ER Conceptual Schema for the COMPANY database



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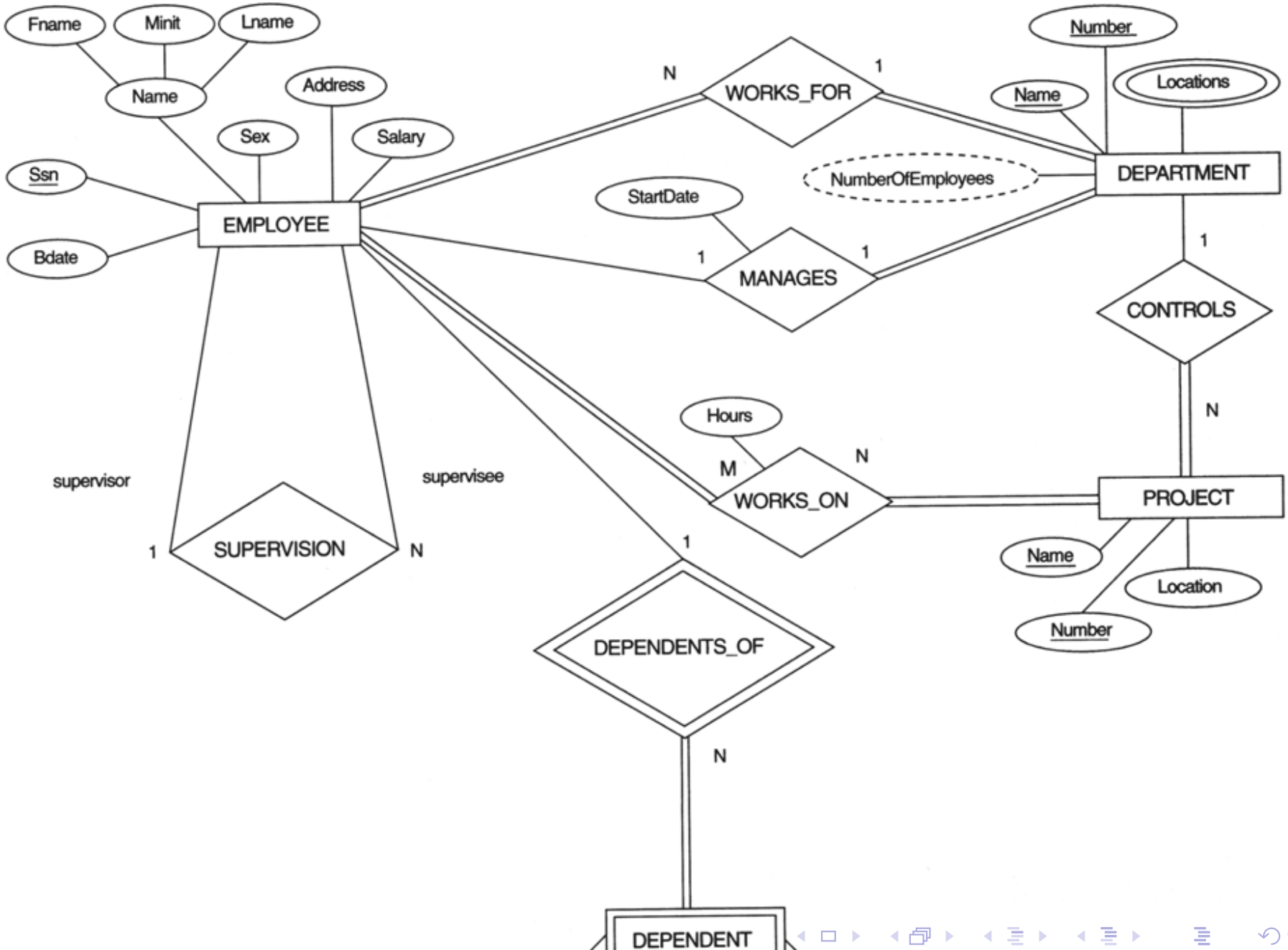
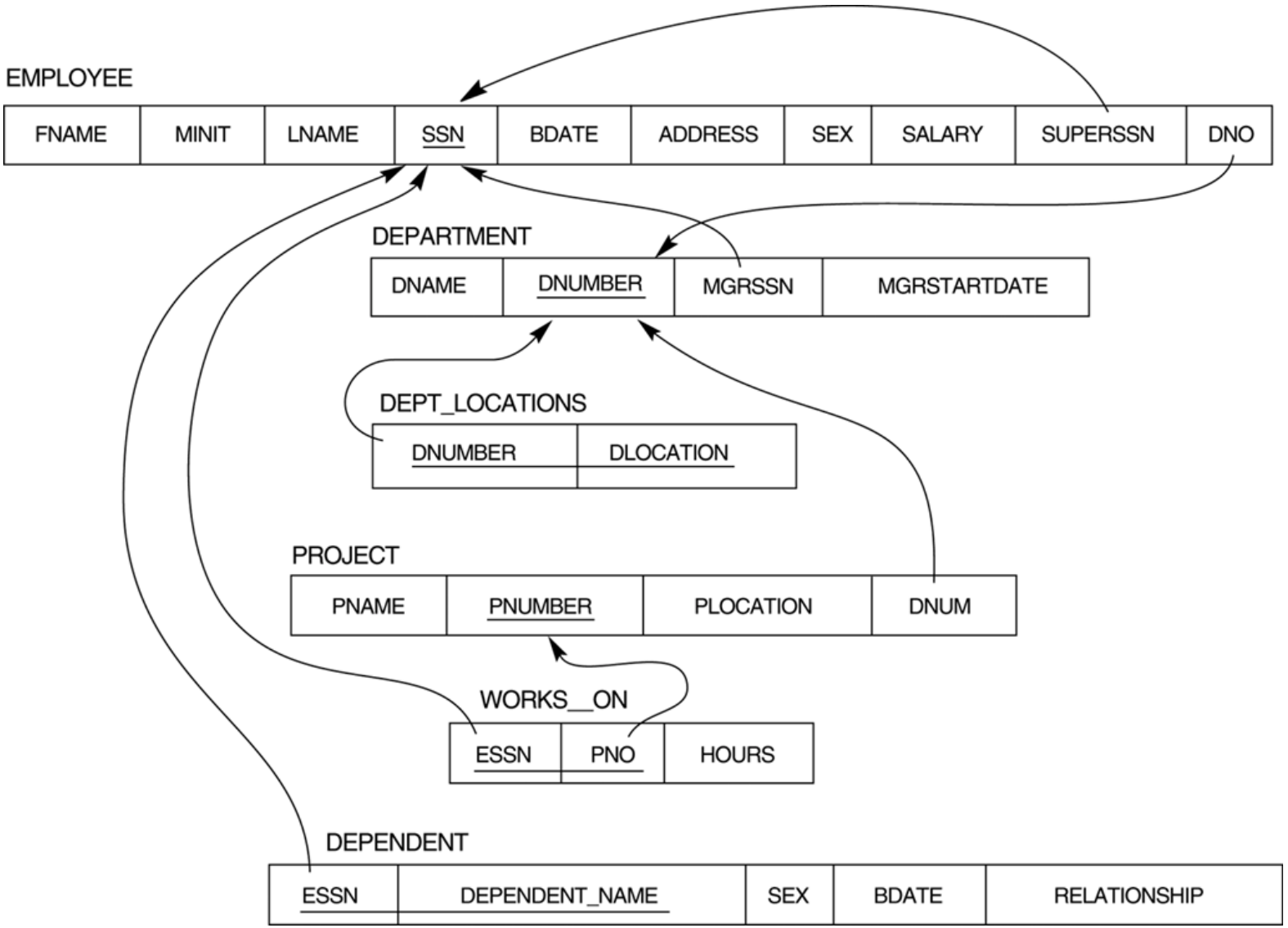


Mapping of the COMPANY ER schema into a relational database schema



ER-to-Relational Mapping Algorithm

- Step 1 : Mapping of Regular Entity Types.
  - For each regular (strong) entity type E in the ER schema, create a relation R that includes all the simple attributes of E.
  - Choose one of the key attributes of E as the primary key for R. If the chosen key of E is composite, the set of simple attributes that form it will together form the primary key of R.

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ER-to-Relational Mapping Algorithm

- Step 2 : Mapping of Weak Entity Types
  - For each weak entity type W in the ER schema with owner entity type E, create a relation R and include all simple attributes (or simple components of composite attributes) of W as attributes of R.
  - In addition, include as foreign key attributes of R the primary key attribute(s) of the relation(s) that correspond to the owner entity type(s).
  - The primary key of R is the combination of the primary key(s) of the owner(s) and the partial key of the weak entity type W, if any.

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ER-to-Relational Mapping Algorithm

- Step 3 : Mapping of Binary 1:1 Relationship Types
  - For each binary 1:1 relationship type R in the ER schema, identify the relations S and T that correspond to the entity types participating in R. Possible approaches include:
    1. **Foreign Key approach** : Choose one of the relations S and include a foreign key in S the primary key of T. It is better to choose an entity type with total participation in R in the role of S.
    2. **Merged relation option** : An alternate mapping of a 1:1 relationship type is possible by merging the two entity types and the relationship into a single relation. This may be appropriate when both participations are total.

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ER-to-Relational Mapping Algorithm

- Step 4 : Mapping of Binary 1:N Relationship Types.
  - For each regular binary 1:N relationship type R, identify the relation S that represent the participating entity type at the N-side of the relationship type.
  - Include as foreign key in S the primary key of the relation T that represents the other entity type participating in R.
  - Include any simple attributes of the 1:N relation type as attributes of S.

ER-to-Relational Mapping Algorithm

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ER-to-Relational Mapping Algorithm

- Step 5 : Mapping of Binary M:N Relationship Types.
  - For each regular binary M:N relationship type R, create a new relation S to represent R.
  - Include as foreign key attributes in S the primary keys of the relations that represent the participating entity types; their combination will form the primary key of S.
  - Also include any simple attributes of the M:N relationship type (or simple components of composite attributes) as attributes of S.

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ER-to-Relational Mapping Algorithm

- Step 6 : Mapping of Multivalued attributes.
  - For each multivalued attribute A, create a new relation R. This relation R will include an attribute corresponding to A, plus the primary key attribute K-as a foreign key in R-of the relation that represents the entity type of relationship type that has A as an attribute.
  - The primary key of R is the combination of A and K. If the multivalued attribute is composite, we include its simple components.

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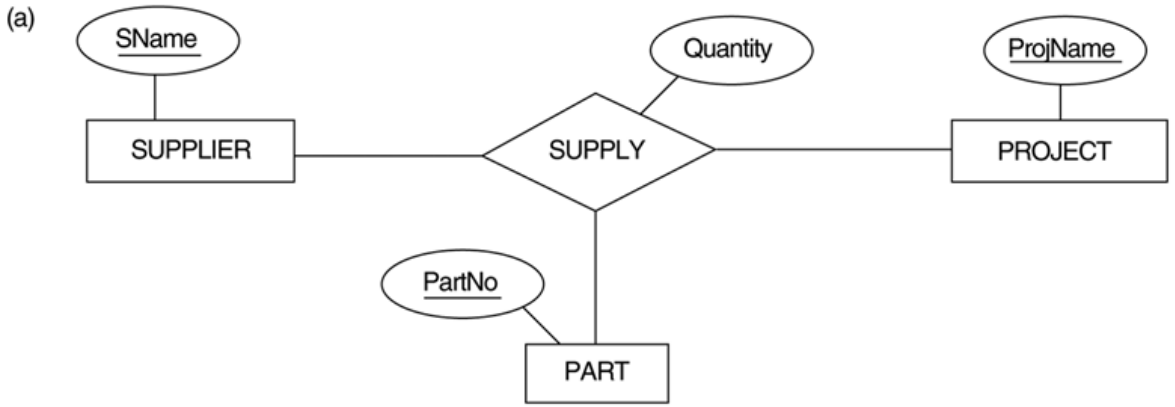
ER-to-Relational Mapping Algorithm

- Step 7 : Mapping of N-ary Relationship Types.
  - For each n-ary relationship type R, where $n > 2$, create a new relationship S to represent R.
  - Include as foreign key attributes in S the primary keys of the relations that represent the participating entity types.
  - Also include any simple attributes of the n-ary relationship type (or simple components of composite attributes) as attributes of S.

Mapping of N-ary Relationship Types



SUPPLY

SNAME	PROJNAME	PARTNO	QUANTITY

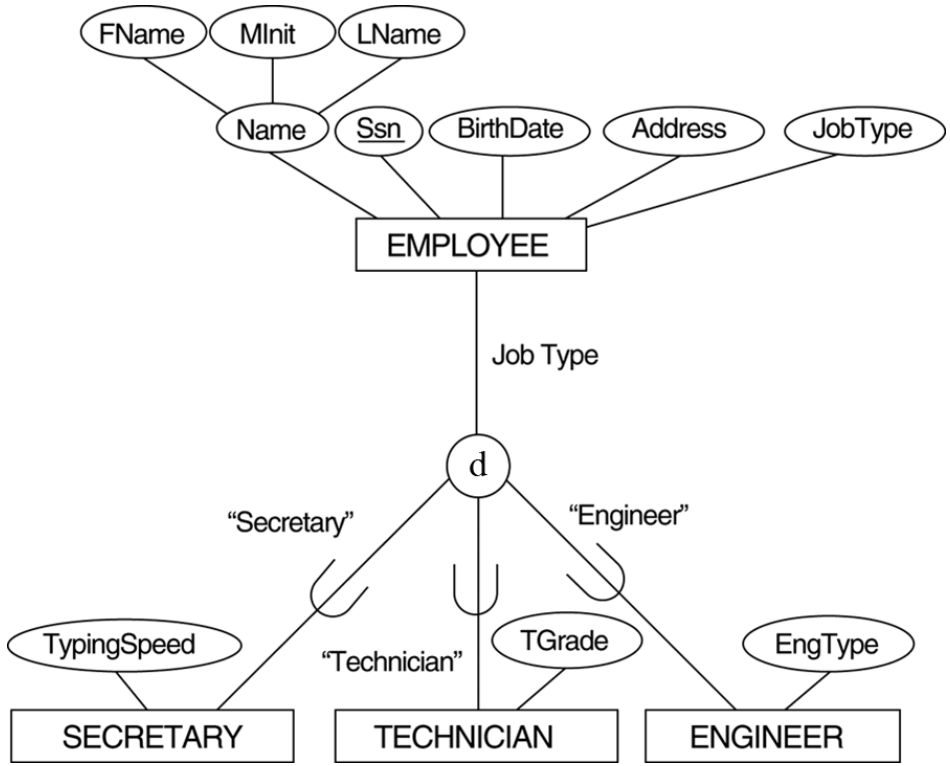
Mapping EER Model Constructs

- Step8: Mapping Specialization or Generalization.
  - Convert each specialization with m subclasses $\{S_1, S_2, \ldots, S_m\}$ and generalized superclass C, where the attributes of C are $\{k, a_1, \ldots, a_n\}$ and k is the (primary) key, into relational schemas using one of the four following options:
    A. Multiple relations-Superclass and subclasses.
    B. Multiple relations-Subclass relations only
    C. Single relation with one type attribute.
    D. Single relation with multiple type attributes.

Multiple relations - Superclass and subclasses

- Option 8A
  - Create a relation L for C with attributes Attrs(L) = $\{k, a_1, \ldots, a_n\}$ and PK(L) = k. Create a relation L_i for each subclass S_i, $1 \leq i \leq m$, with the attributes Attrs(L_i) = $\{k\} \cup \{$attributes of $S_i\}$ and $PK(L_i) = k$. This option works for any specialization (total or partial, disjoint of over- lapping).

Consider the ER model



This maps to:

(a)

EMPLOYEE

SSN	FName	MInit	LName	BirthDate	Address	JobType

SECRETARY

SSN	TypingSpeed

TECHNICIAN

SSN	TGrade

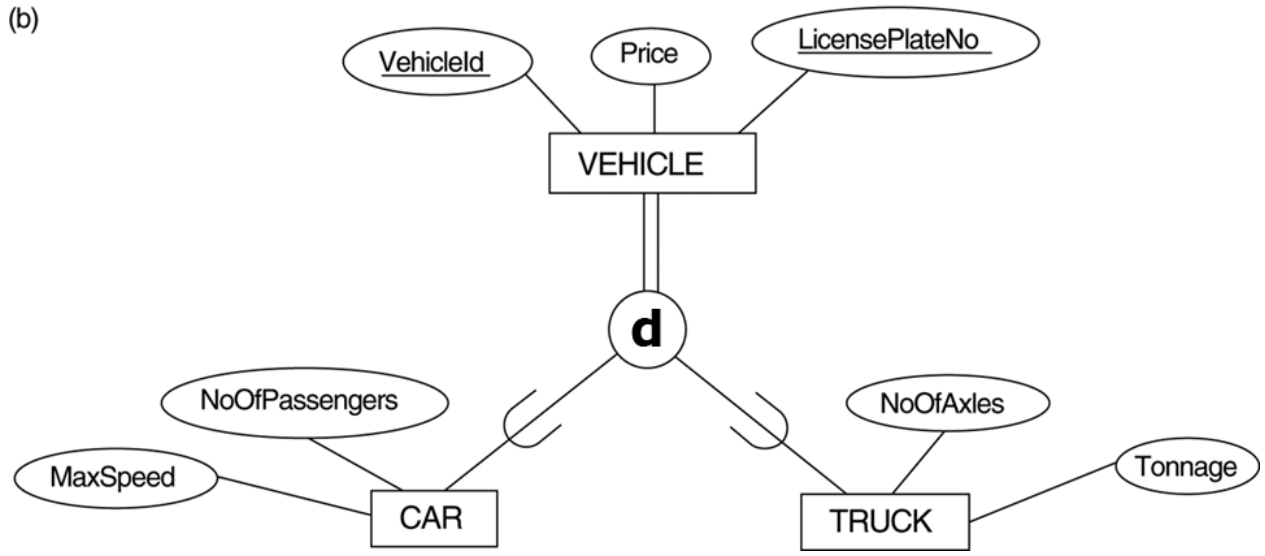
ENGINEER

SSN	EngType

Multiple relations-Subclass relations only

- Option 8B
  - Create a relation L_i for each subclass S_i, $1 \leq i \leq m$, with the attributes $\text{Attr}(L_i) = \{\text{attributes of } S_i\} \cup \{k, a_1, \ldots, a_n\}$ and $\text{PK}(L_i) = k$. This option only works for a specialization whose subclasses are total (every entity in the superclass must belong to (at least) one of the subclasses).

Consider the ER model



This maps to:

(b) CAR

VehicleId	LicensePlateNo	Price	MaxSpeed	NoOfPassengers

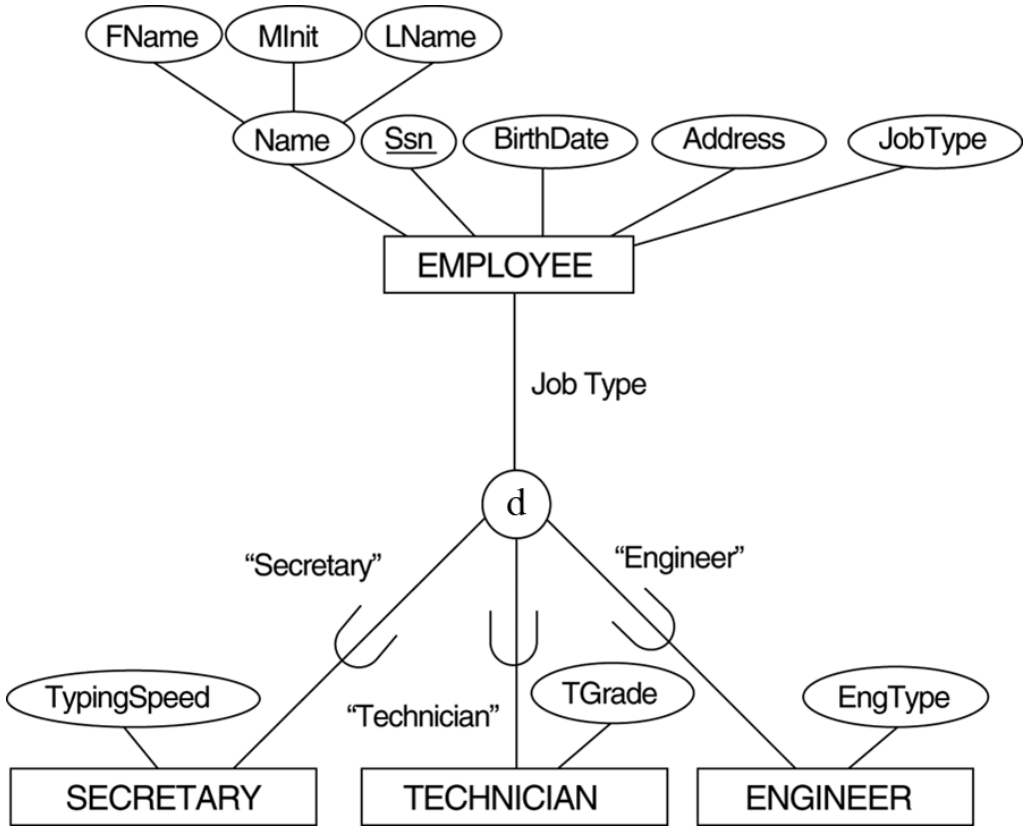
TRUCK

VehicleId	LicensePlateNo	Price	NoOfAxles	Tonnage

Single relation with one type attribute

- Option 8C
  - Create a single relation L with attributes $\text{Attrs}(L) = \{k, a_1, \ldots, a_n\} \cup \{\text{attributes of } S_1\} \cup \ldots \cup \{\text{attributes of } S_m\} \cup \{t\}$ and $\text{PK}(L) = k$. The attribute t is called a type (or discriminating) attribute that indicates the subclass to which each tuple belongs

Consider the ER model



This maps to:

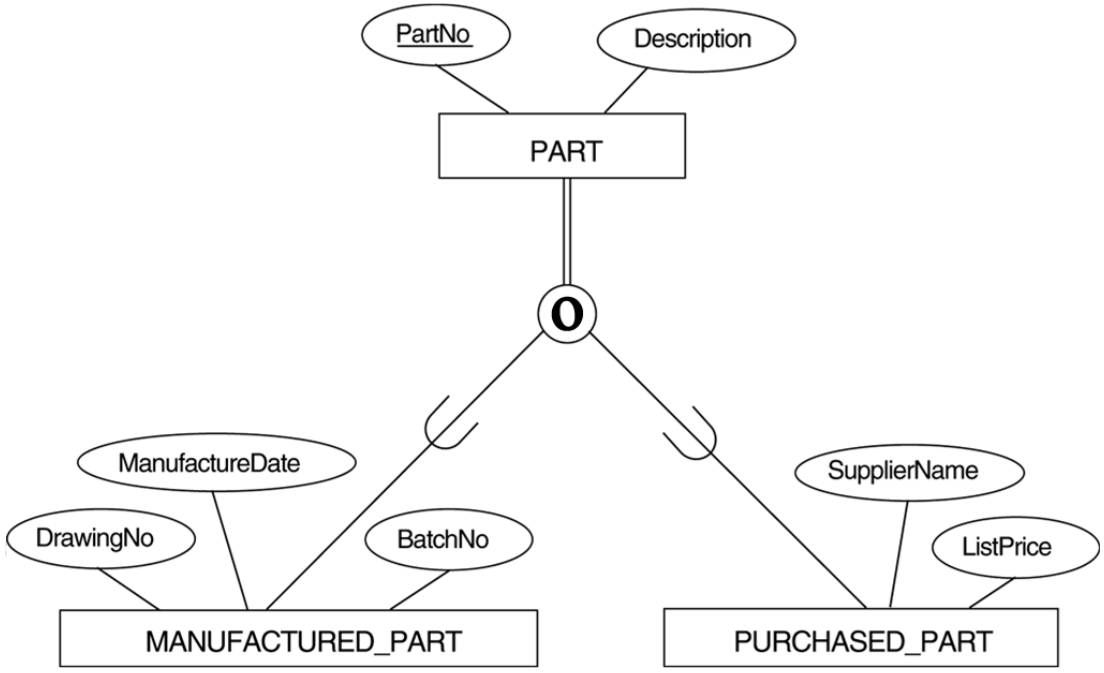
(c) EMPLOYEE

SSN	FName	MInit	LName	BirthDate	Address	JobType	TypingSpeed	TGrade	EngType

Single relation with multiple type attributes

- Option 8D
  - Create a single relation schema L with attributes $\text{Attrs}(L) = \{k, a_1, \ldots, a_n\} \cup \{\text{attributes of } S_1\} \cup \ldots \cup \{\text{attributes of } S_m\} \cup \{t_1, t_2, \ldots, t_m\}$ and $\text{PK}(L) = k$. Each t_i, $1 \leq i \leq m$, is a Boolean type attribute indicating whether a tuple belongs to the subclass S_i.

Consider the ER model



This maps to:

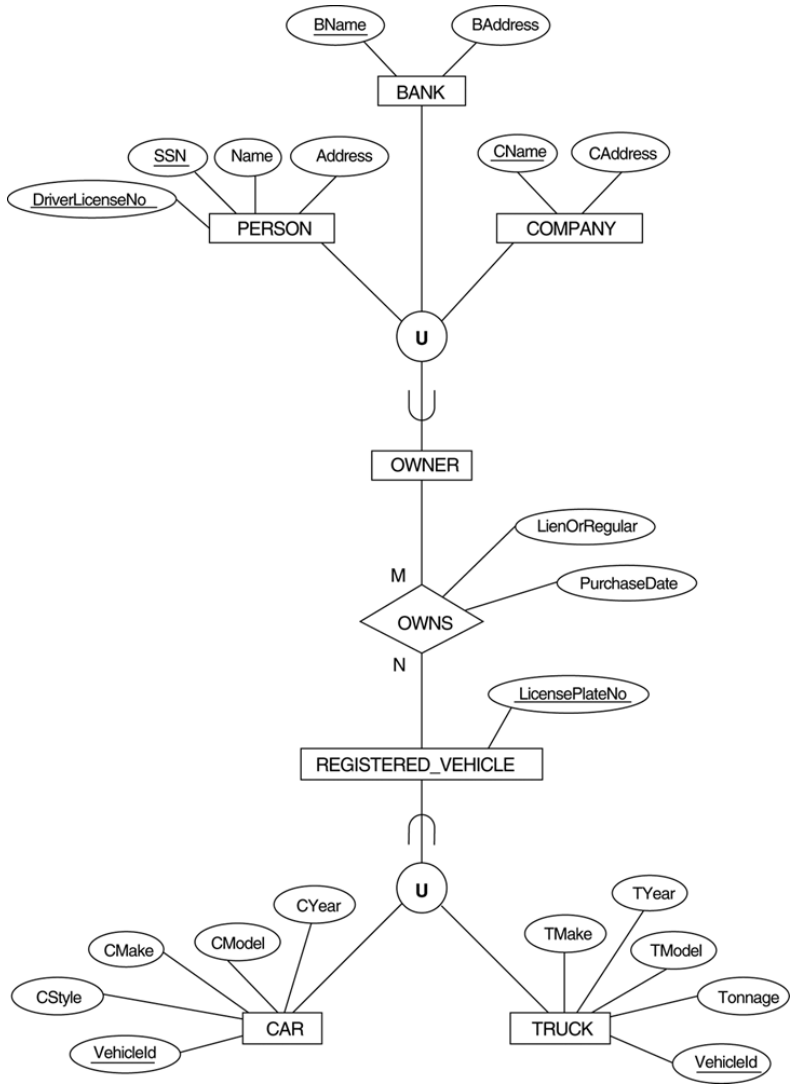
(d) PART

PartNo	Description	MFlag	DrawingNo	ManufactureDate	BatchNo	PFlag	SupplierName	ListPrice

Mapping EER Model Constructs

- Step 9: Mapping of Union Types (Categories).
  - For mapping a category whose defining superclass have different keys, it is customary to specify a new key attribute, called a surrogate key, when creating a relation to correspond to the category.
  - Example: we can create a relation OWNER to correspond to the OWNER category and include any attributes of the category in this relation. The primary key of the OWNER relation is the surrogate key, which we called OwnerId.

Consider the ER model



This maps to:

PERSON

SSN	DriverLicenseNo	Name	Address	OwnerId

BANK

BName	BAddress	OwnerId

COMPANY

CName	CAddress	OwnerId

OWNER

OwnerId

REGISTERED_VEHICLE

VehicleId	LicensePlateNumber

CAR

VehicleId	CStyle	CMake	CModel	CYear

TRUCK

VehicleId	TMake	TModel	Tonnage	TYear

OWNS

OwnerId	VehicleId	PurchaseDate	LienOrRegular