

Database Systems

ER Model – Types/ SubTypes

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Supertypes and Subtypes

- **Supertype:** A generic entity type that has a relationship with one or more subtypes
- **Subtype:** A subgrouping of the entities in an entity type which has attributes that are distinct from those in other subgroupings
- **Attribute Inheritance:**
 - Subtype entities inherit values of all attributes of the supertype
 - An instance of a subtype is also an instance of the supertype

Sounds like object-oriented?



Subtype Entities

- A **subtype** entity is a special case of another entity called its **supertype**.
- Subtypes can be *exclusive* or *inclusive*.
 - If **exclusive**, the supertype relates to at most one subtype.
 - If **inclusive**, the supertype can relate to one or more subtypes.

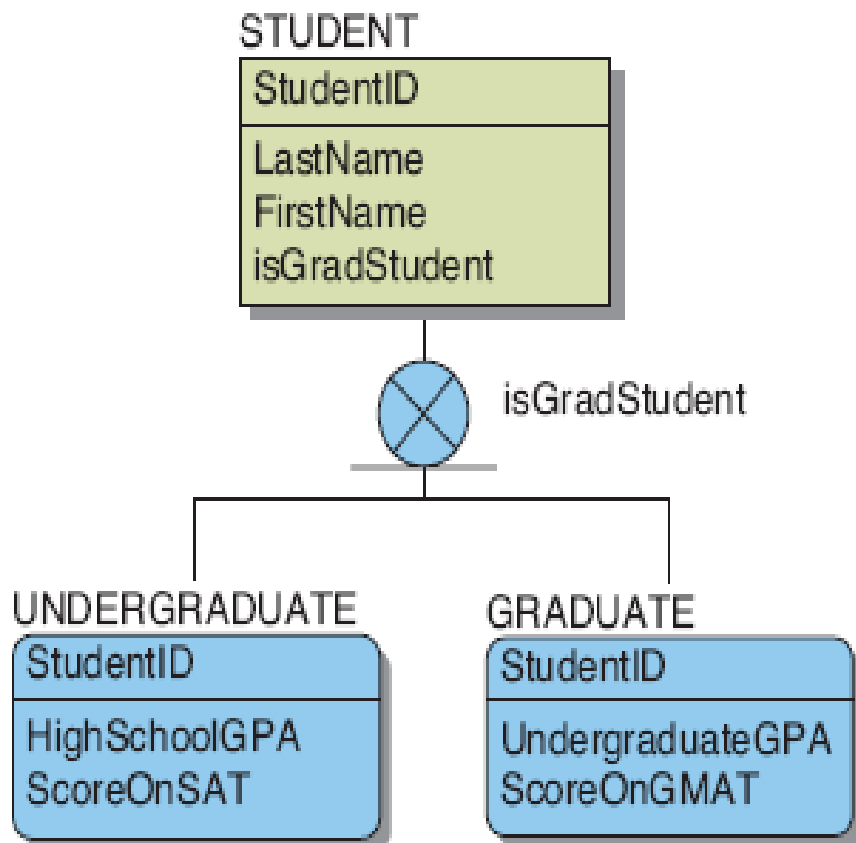


Subtype Entity Identifiers

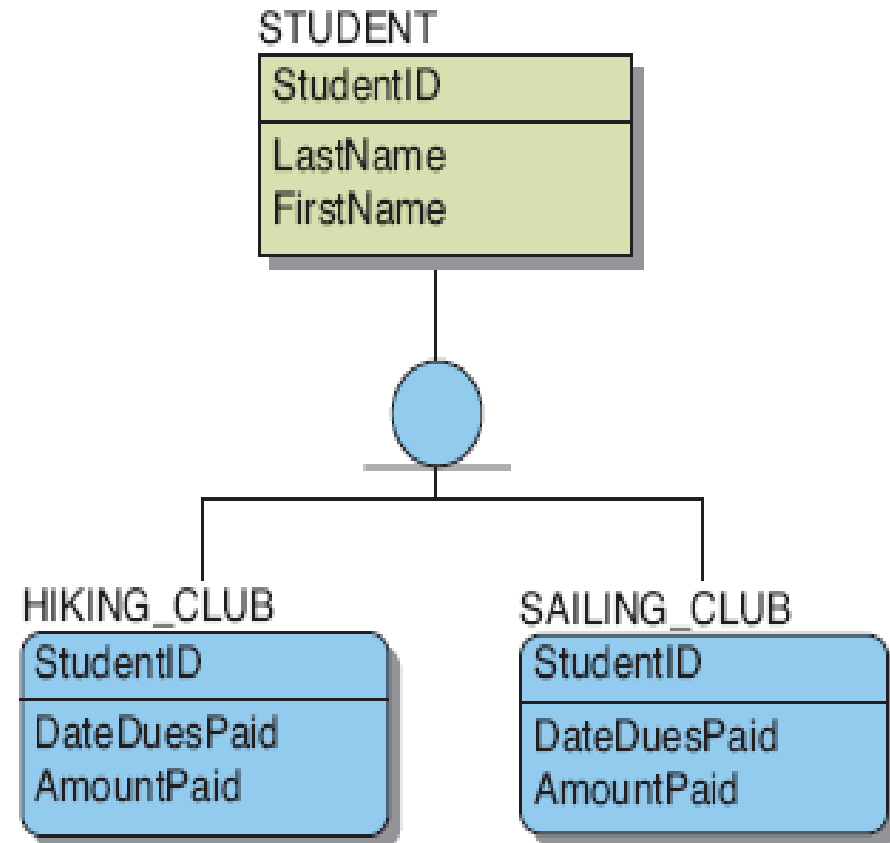
- The relationships that connect supertypes and subtypes are called **IS-A relationships** because a subtype is the same entity as the supertype
- The identifier/primary key of a supertype and all of its subtypes is the same attribute



Subtype Entity Examples



(a) Exclusive Subtypes with Discriminator



(b) Indusive Subtypes

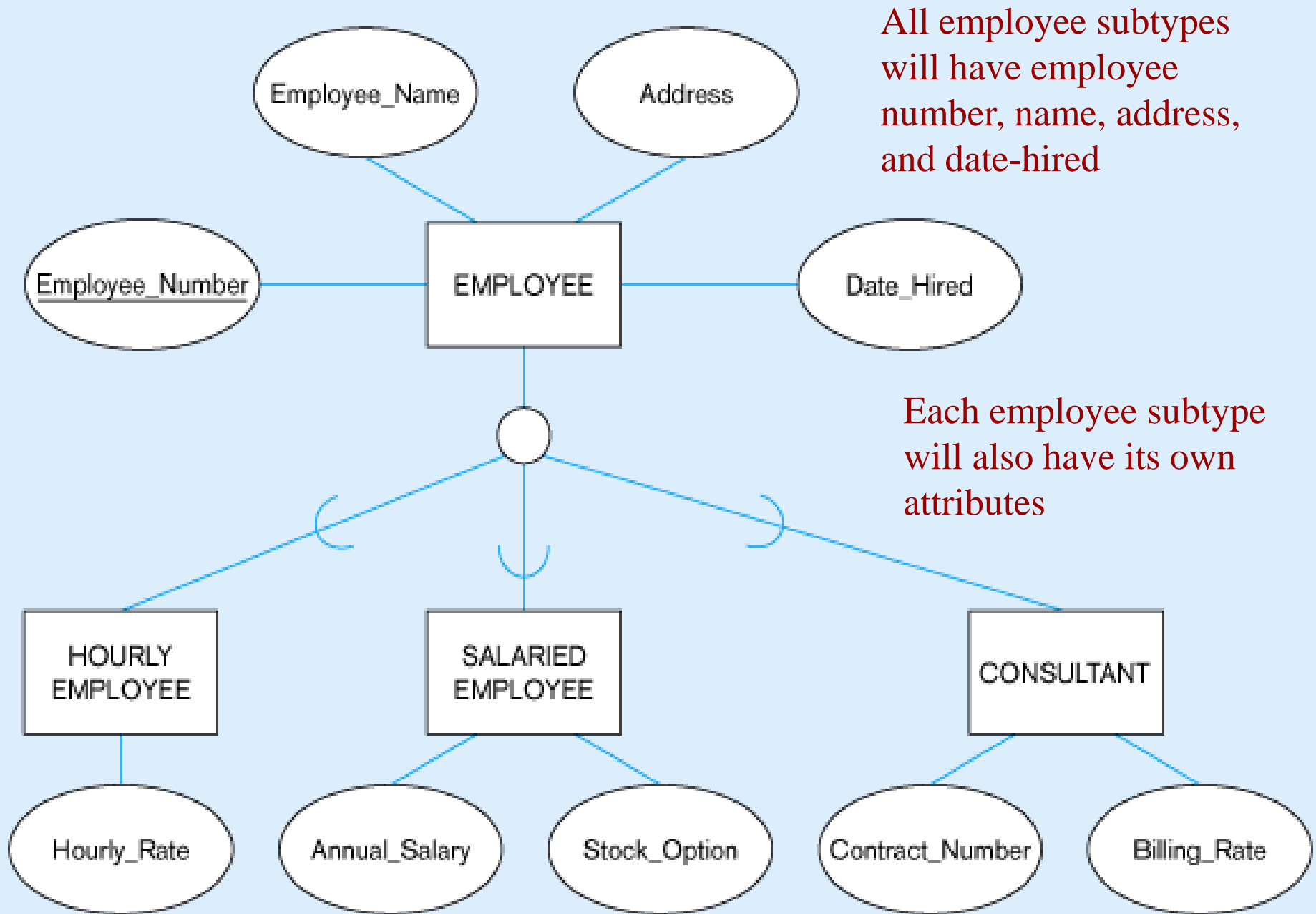
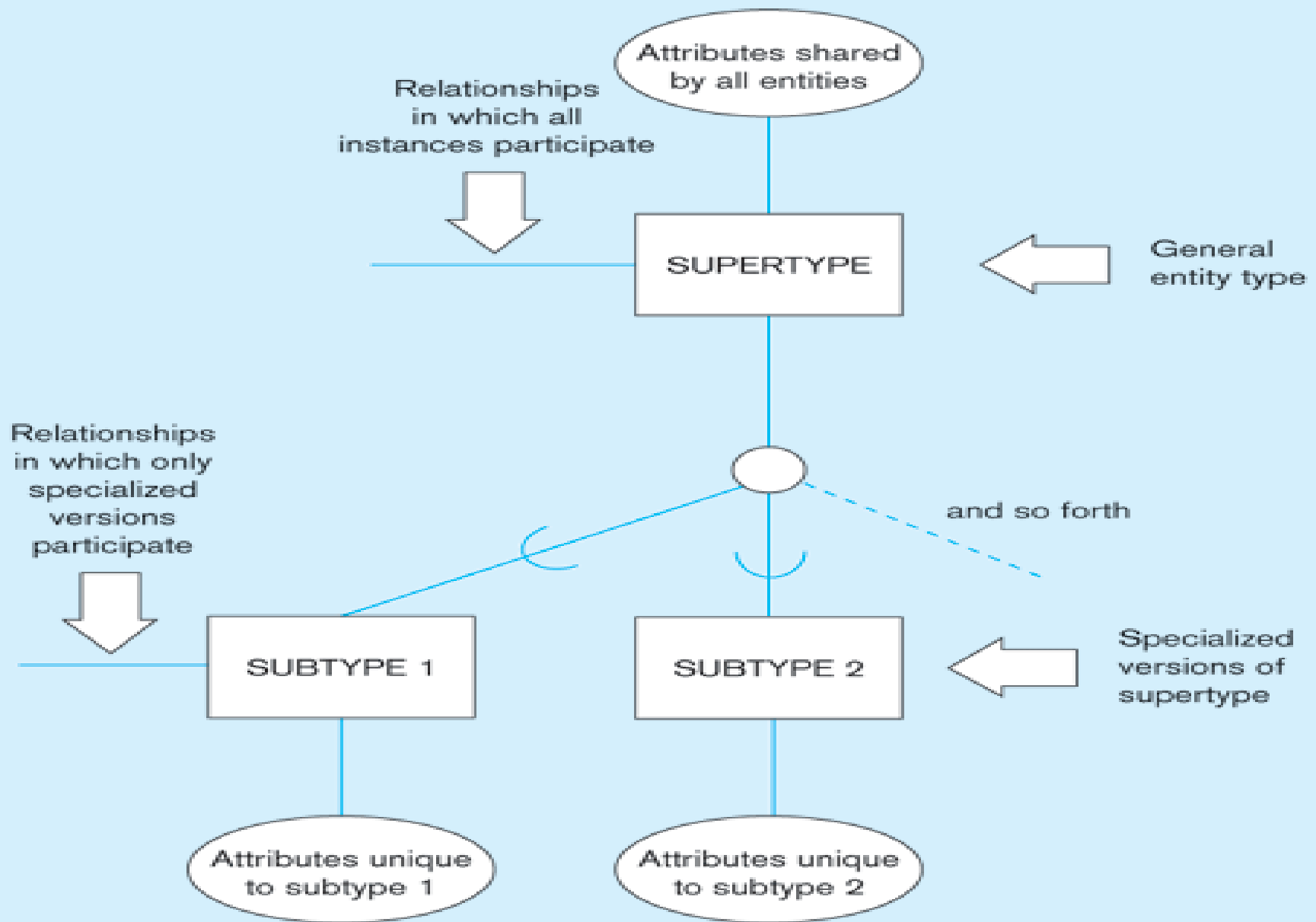
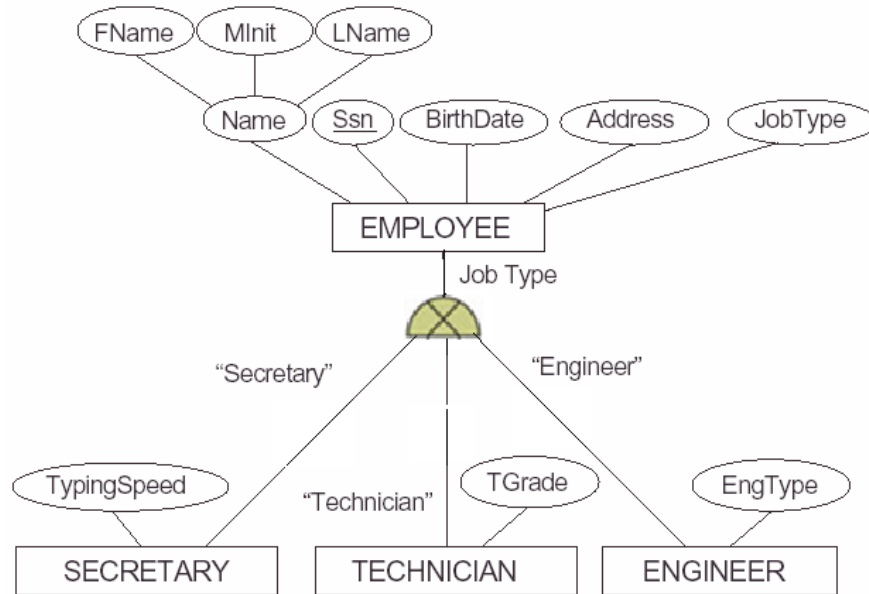


Figure 4-2 – Employee supertype with three subtypes

Figure 4-1a Basic notation for supertype/subtype relationships - Traditional EER notation



Disjoint Exclusive Relationship Mapping



<u>SSN</u>	Fname	Minit	Lname	Bdate	Address	Jobtype
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SECRETARY

<u>SSN</u>	TypingSpeed
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TECHNICIAN

<u>SSN</u>	TGrade
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ENGINEER

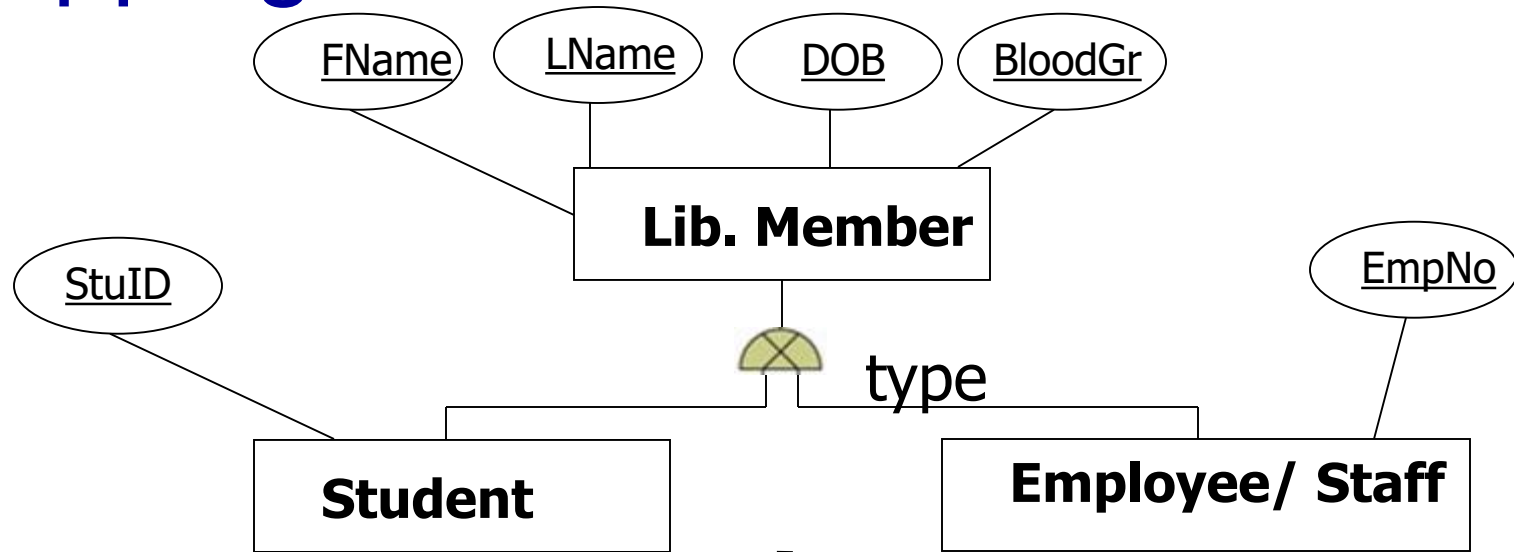
<u>SSN</u>	EngType
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ER Model

Relational Schema/
Table Design

Disjoint Exclusive Relationship Mapping



ER Model

Relational Schema/ Table Design

LibMember

<u>CardID</u>	FName	LName	DOB	BloodGroup	MemberType
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Note: Any two entities which have same attributes domains can be mapped together into one table. This requires an additional attribute to identify types.

Examples: A STUDENT has a DegreeType either UG, Master or PhD. A PERSON has a NationalityType either Citizen or Foreigner



Inclusive Relationship Mapping

- In a hospital all employees such as doctors, nurses and other medical staff are the patient as well. Then draw their subtype ER.

Generalization and Specialization

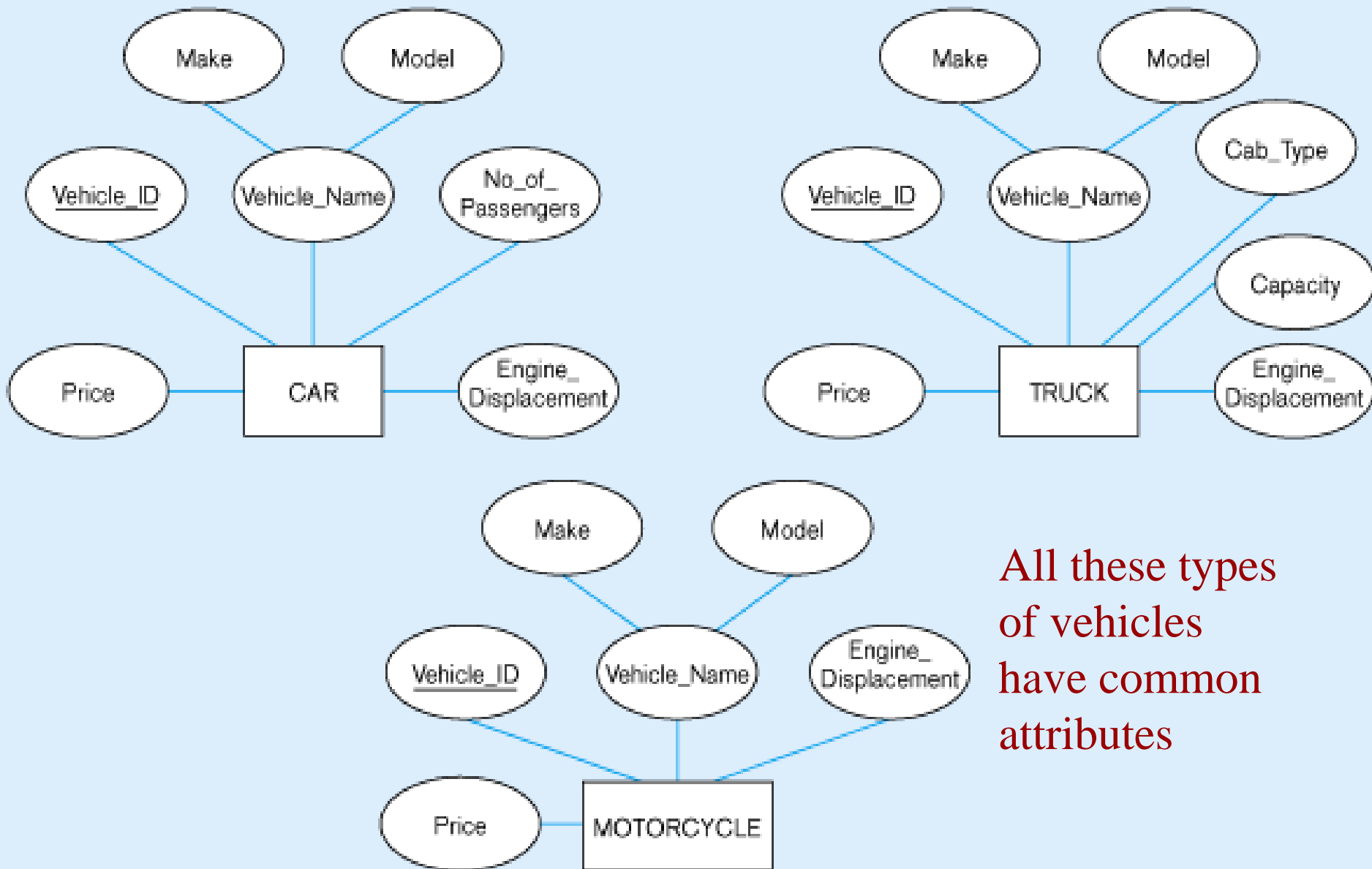


- **Generalization:** The process of defining a more general entity type from a set of more specialized entity types. BOTTOM-UP
- **Specialization:** The process of defining one or more subtypes of the supertype, and forming supertype/subtype relationships. TOP-DOWN

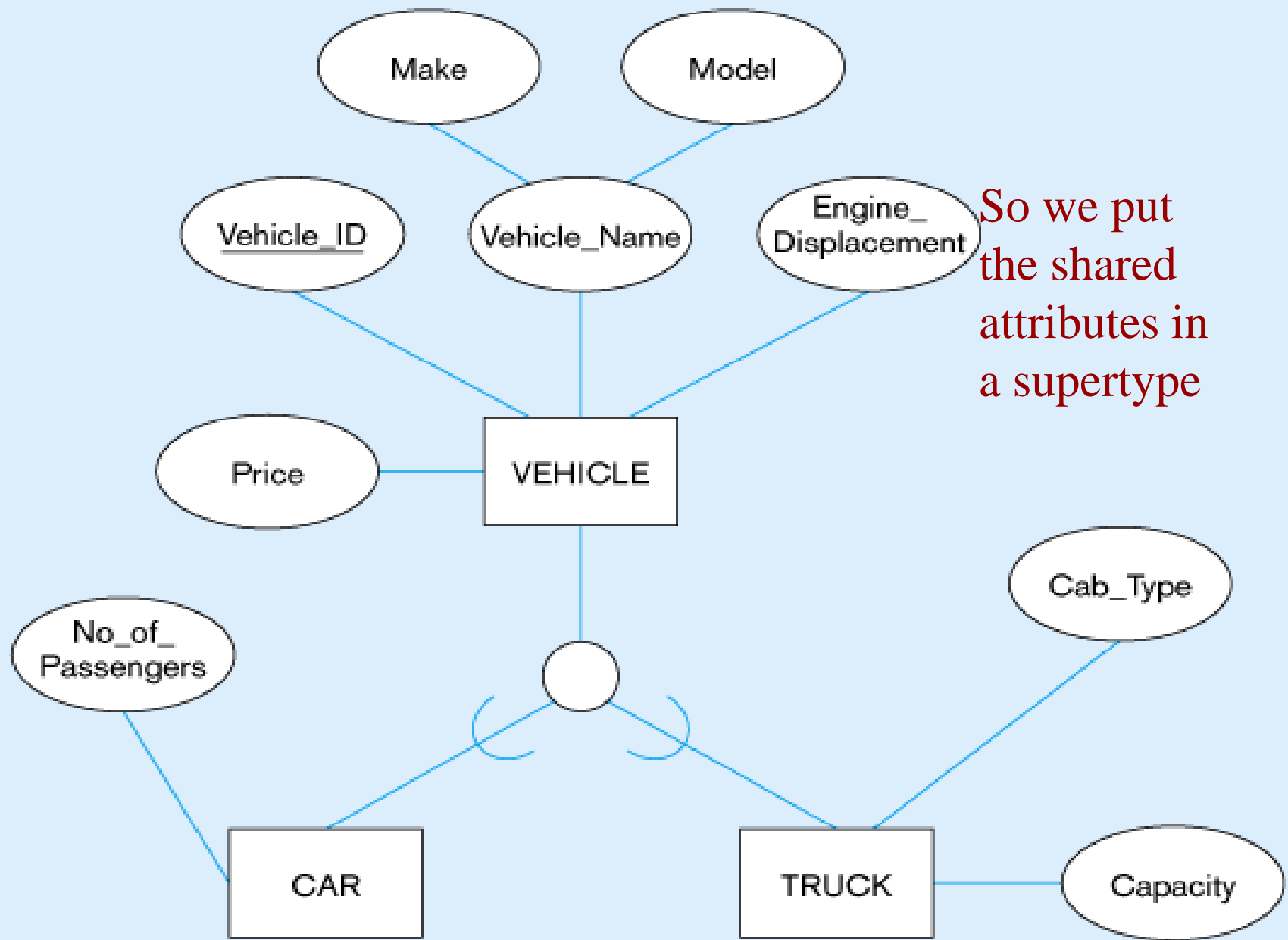
Example of generalization



Notice anything?



All these types
of vehicles
have common
attributes



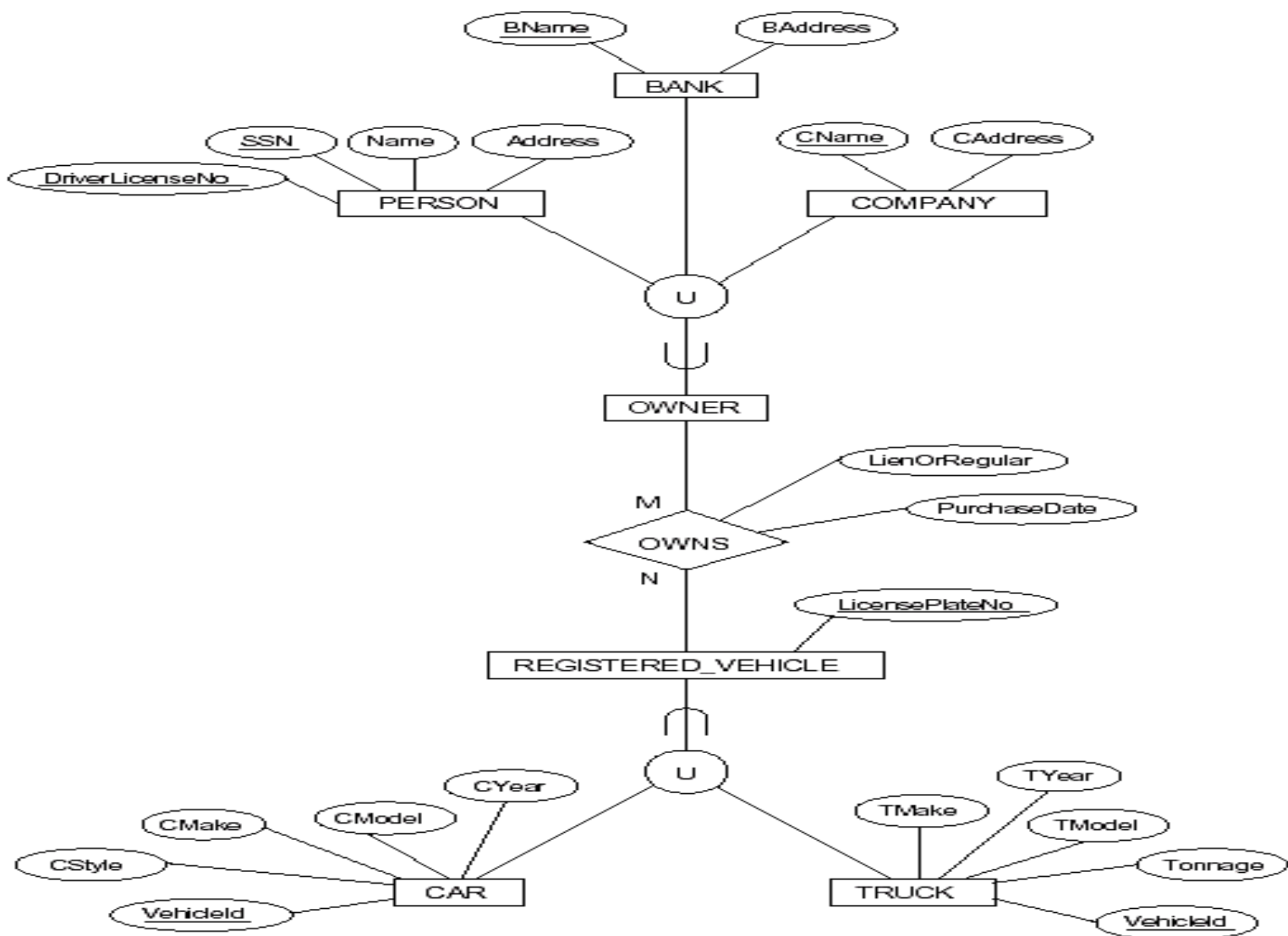
Note: no subtype for motorcycle, since it has no unique attributes

Generalization to VEHICLE supertype



- Categorization

- **Categorization** (Union) is the modeling of a single subclass (called a category) with a relationship that involves more than one distinct superclasses.
- A **category** is a subset of the **union** of its superclasses. Hence an entity which is a member of a category must exist in only one of the superclasses.
- In a category, subclass has selective inheritance.
- Categories can be either total or partial.
 - Total: every occurrence of all superclass must appear in the category.
 - Partial: Some occurrences of all superclasses may not appear in the category.



Constraints in Supertype/ Completeness Constraint

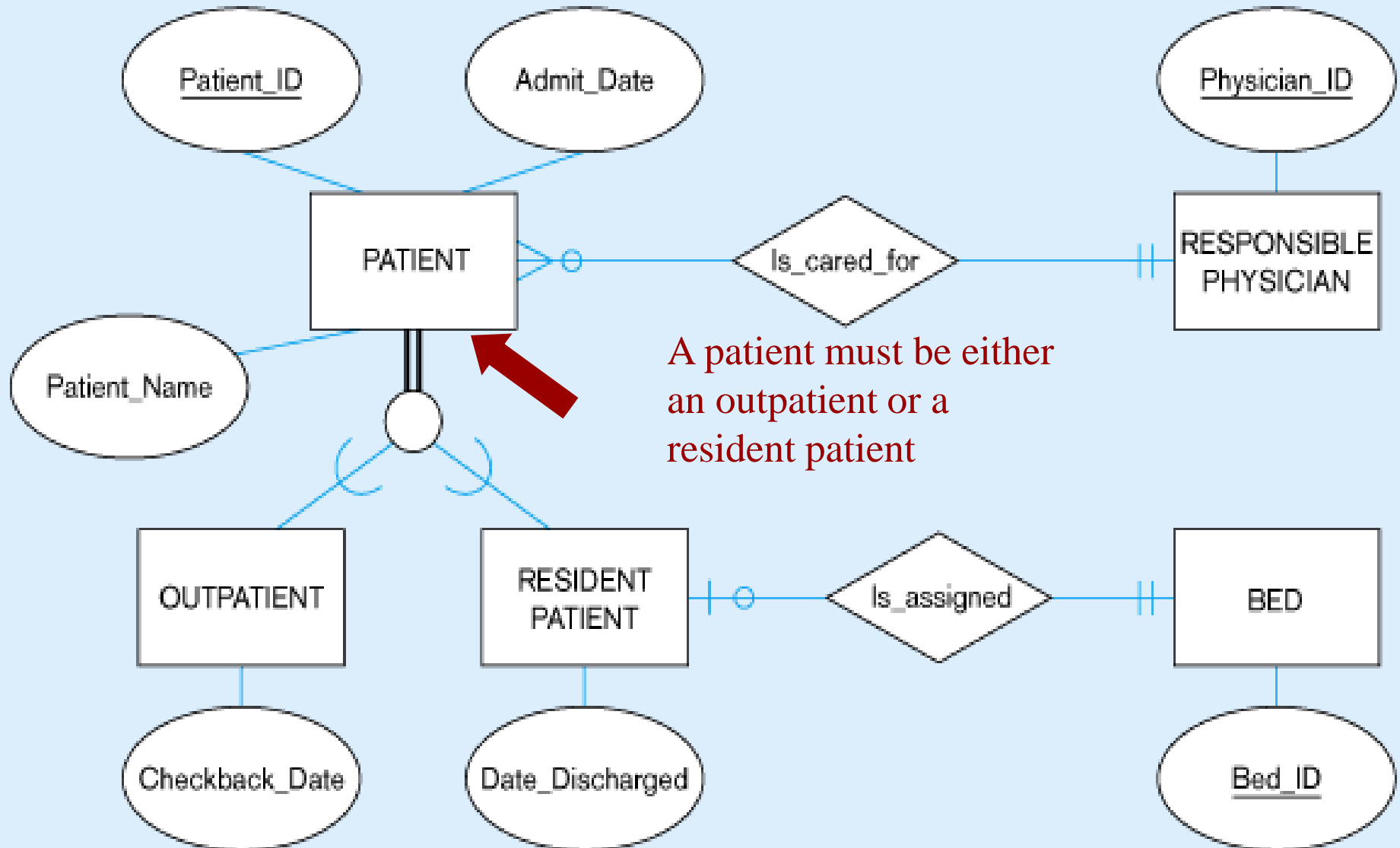


- **Completeness Constraints**: Whether an instance of a supertype *must* also be a member of at least one subtype
 - Total Specialization Rule: (double line)
 - Partial Specialization Rule: (single line)

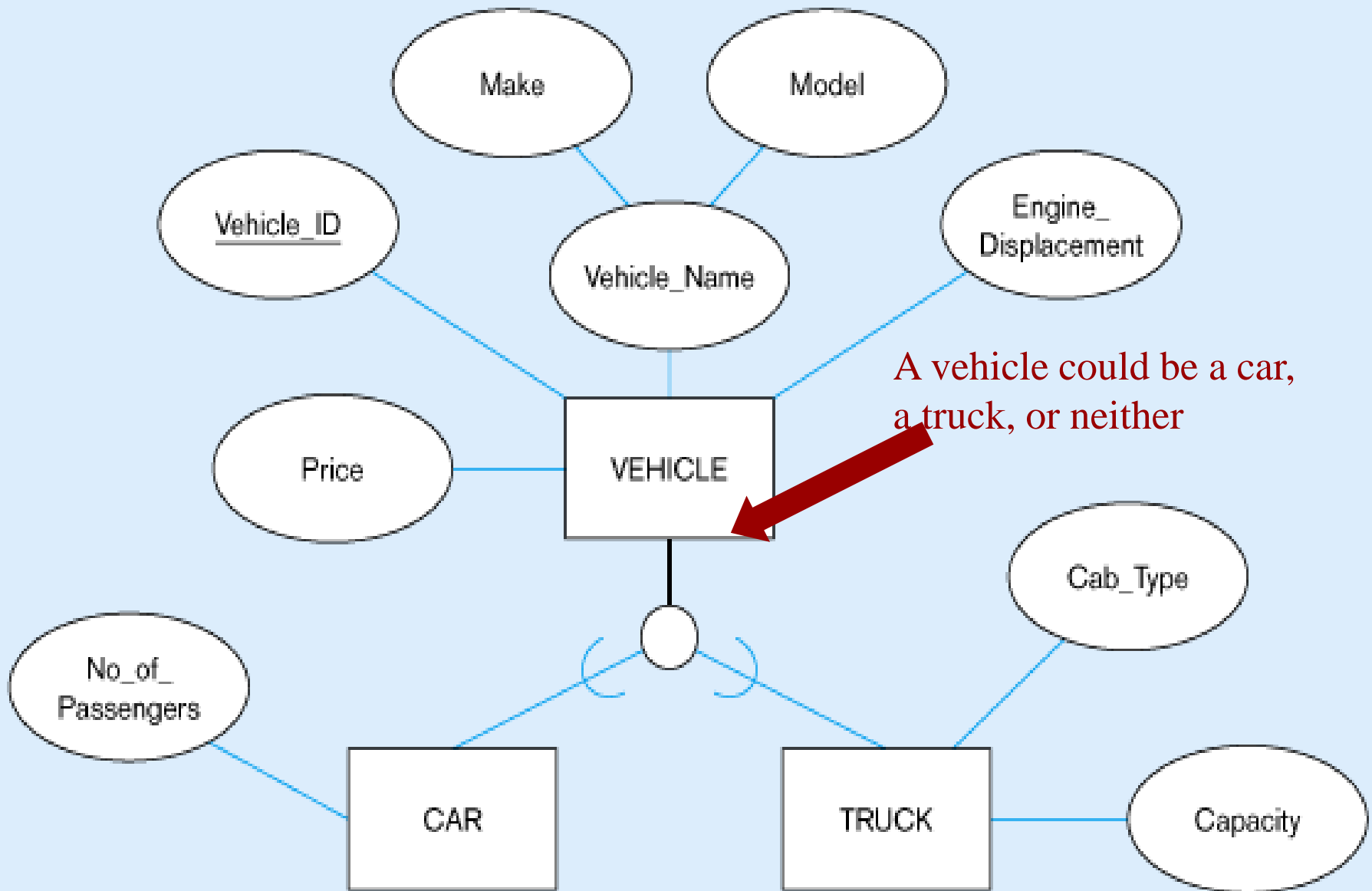
Examples of completeness constraints



Total specialization rule



Partial specialization rule



Constraints in Supertype/

Disjointness constraint

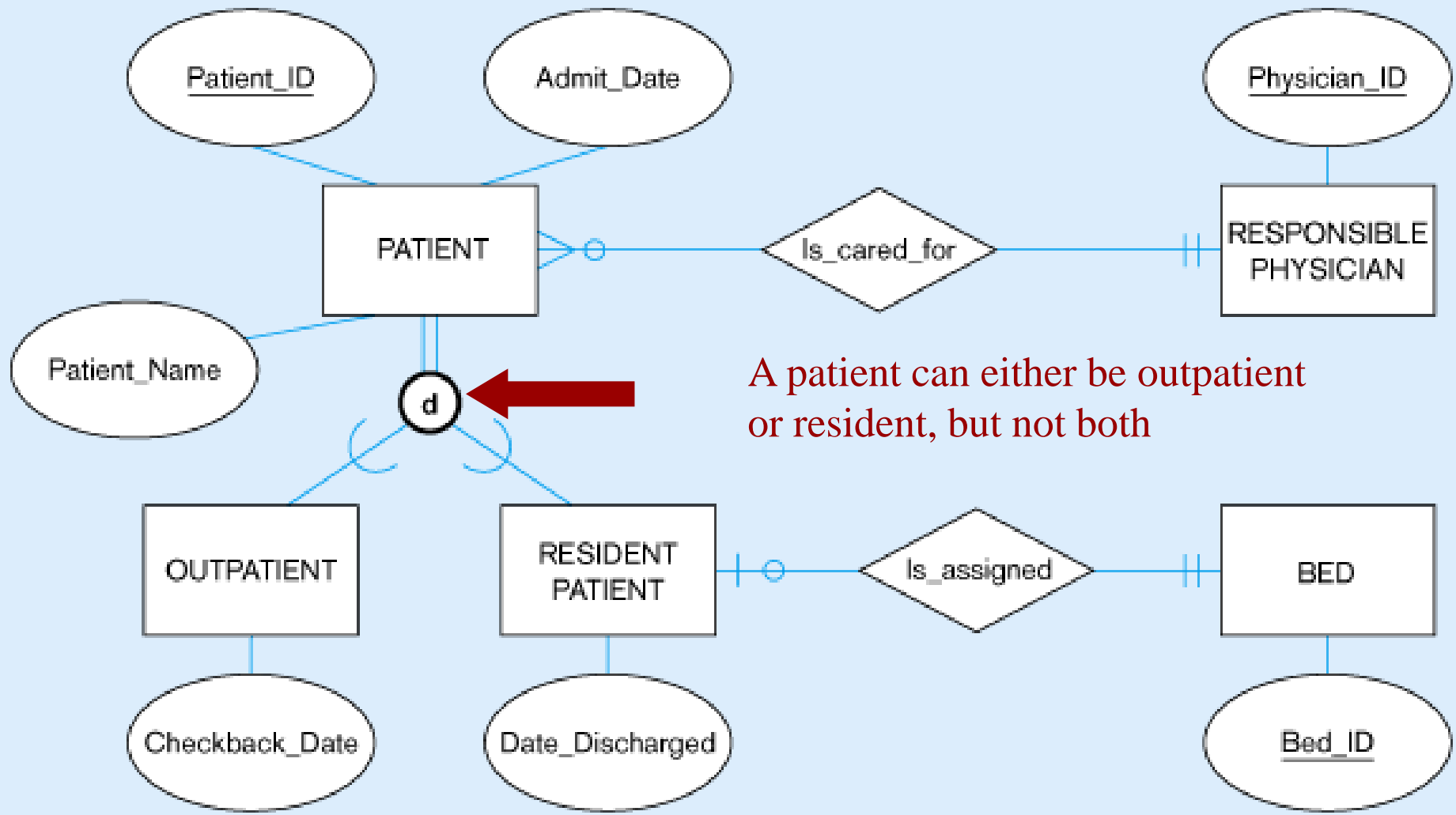


- **Disjointness Constraints**: Whether an instance of a supertype may *simultaneously* be a member of two (or more) subtypes
 - Disjoint Rule: An instance of the supertype can be only ONE of the subtypes
 - Overlap Rule: An instance of the supertype could be more than one of the subtypes

Examples of disjointness constraints

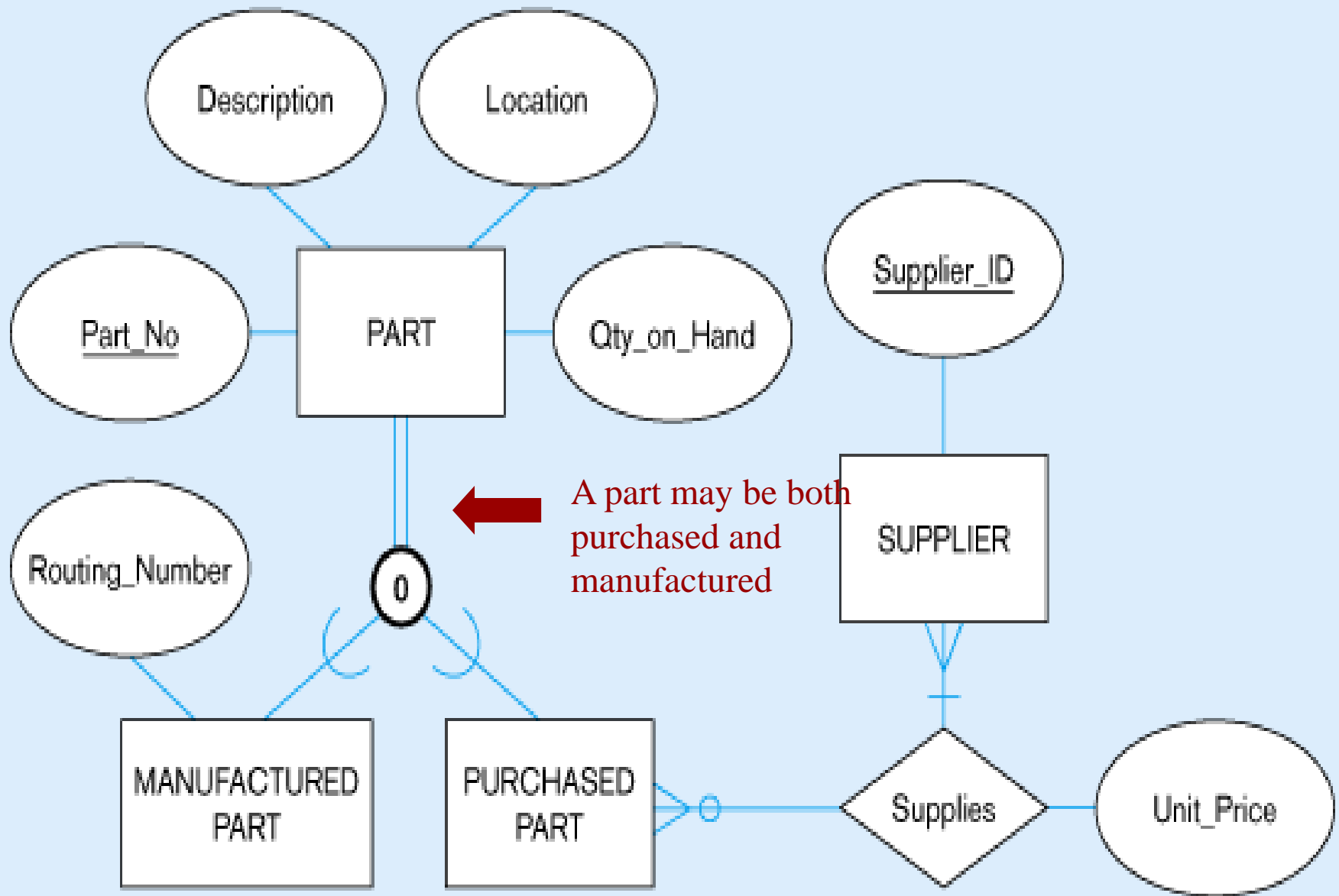


Disjoint rule



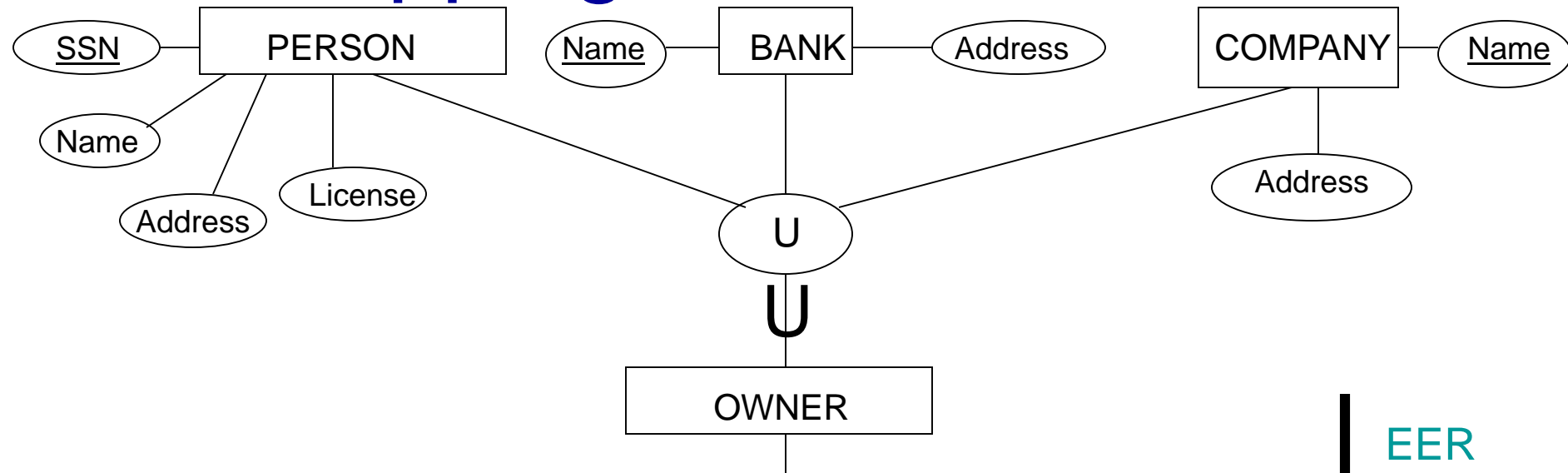
A patient can either be outpatient or resident, but not both

Overlap rule





--- Example: Category Mapping



EER
REL.

PERSON	<u>SSN</u>	License	Name	Address	OwnerId
BANK	<u>BName</u>	BAddress	OwnerId		
COMPANY	<u>CName</u>	CAddress	OwnerId		
OWNER	<u>OwnerId</u>				

Figure 7.5 Schema diagram for the COMPANY relational database schema; the primary keys are underlined.

EMPLOYEE

FNAME	MINIT	LNAME	<u>SSN</u>	BDATE	ADDRESS	SEX	SALARY	SUPERSSN	DNO
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DEPARTMENT

DNAME	<u>DNUMBER</u>	MGRSSN	MGRSTARTDATE
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DEPT_LOCATIONS

<u>DNUMBER</u>	<u>DLOCATION</u>
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PROJECT

PNAME	<u>PNUMBER</u>	PLOCATION	DNUM
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WORKS_ON

<u>ESSN</u>	<u>PNO</u>	HOURS
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DEPENDENT

<u>ESSN</u>	<u>DEPENDENT_NAME</u>	SEX	BDATE	RELATIONSHIP
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Figure 7.7 Referential integrity constraints displayed on the COMPANY relational database schema diagram.

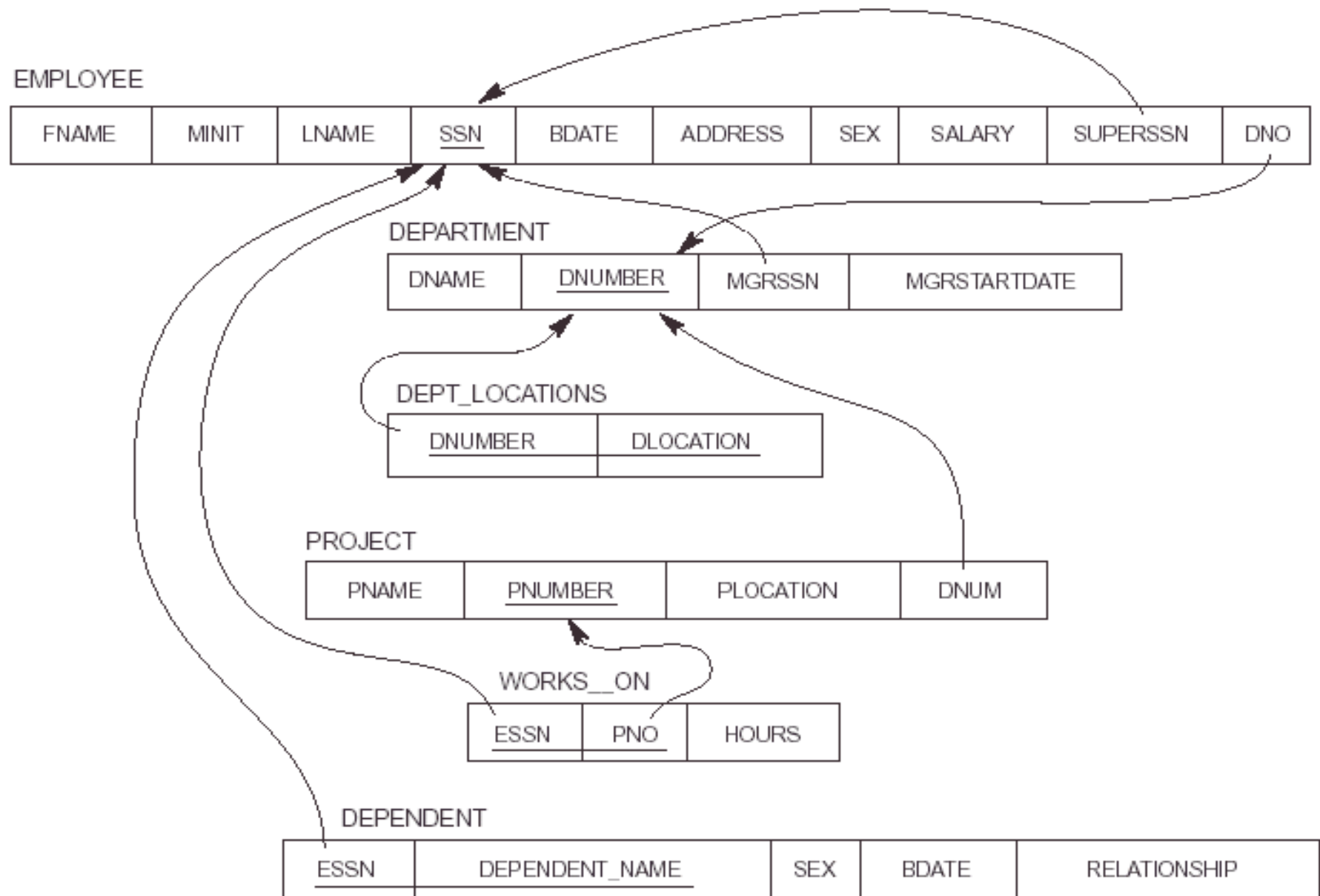


Figure 7.6 One possible relational database state corresponding to the COMPANY schema.

EMPLOYEE	FNAME	MINI	LNAME	<u>SSN</u>	BDATE	ADDRESS	SEX	SALARY	SUPERSSN	DNO
John			Smith	123456789	1985-01-09	731 Fondren, Houston, TX	M	30000	333445555	5
Franklin			Wong	333445555	1985-12-08	635 Voss, Houston, TX	M	40000	888885555	5
Alicia			Zelaya	999887777	1985-01-19	3321 Castle, Spring, TX	F	25000	987654321	4
Jennifer			Wallace	957654321	1941-08-20	291 Barry, Bellaire, TX	F	43000	888885555	4
Ramash			Narayan	888884444	1982-09-15	975 Fira Oak, Humble, TX	M	38000	333445555	5
Joyce			English	453453453	1972-07-31	5531 Rice, Houston, TX	F	25000	333445555	5
Ahmad			Jabbar	957987987	1989-03-29	980 Dallas, Houston, TX	M	25000	987654321	4
James			Borg	888885555	1937-11-10	450 Stone, Houston, TX	M	55000	null	1

DEPARTMENT	DNAME	<u>DNUMBER</u>	MGRSSN	MGRSTARTDATE
	Research	5	333445555	1985-05-22
	Administration	4	957654321	1985-01-01
	Headquarters	1	888885555	1981-06-19

DEPT_LOCATIONS	<u>DNUMBER</u>	DLOCATION
		Houston
		Stafford
		Bellaire
		Sugarland

WORKS_ON	<u>ESSN</u>	<u>PNO</u>	HOURS
	123456789	1	32.5
	123456789	2	7.5
	888884444	3	40.0
	453453453	1	20.0
	453453453	2	20.0
	333445555	2	10.0
	333445555	3	10.0
	333445555	10	10.0
	333445555	20	10.0
	999887777	30	30.0
	999887777	10	10.0
	957987987	10	35.0
	957987987	30	5.0
	957654321	30	20.0
	957654321	20	15.0
	888885555	20	null

PROJECT	PNAME	<u>PNUMBER</u>	PLOCATION	DNUM
	ProductX	1	Bellaire	5
	ProductY	2	Sugarland	5
	ProductZ	3	Houston	5
	Computerization	10	Stafford	4
	Reorganization	20	Houston	1
	Newbenefits	30	Stafford	4

DEPENDENT	<u>ESSN</u>	<u>DEPENDENT_NAME</u>	SEX	BDATE	RELATIONSHIP
	333445555	Alice	F	1985-04-05	DAUGHTER
	333445555	Theodore	M	1983-10-25	SON
	333445555	Joy	F	1985-05-03	SPOUSE
	957654321	Abner	M	1942-02-25	SPOUSE
	123456789	Michael	M	1985-01-04	SON
	123456789	Alice	F	1985-12-30	DAUGHTER
	123456789	Elizabeth	F	1987-05-05	SPOUSE