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From ER to the Relational Model

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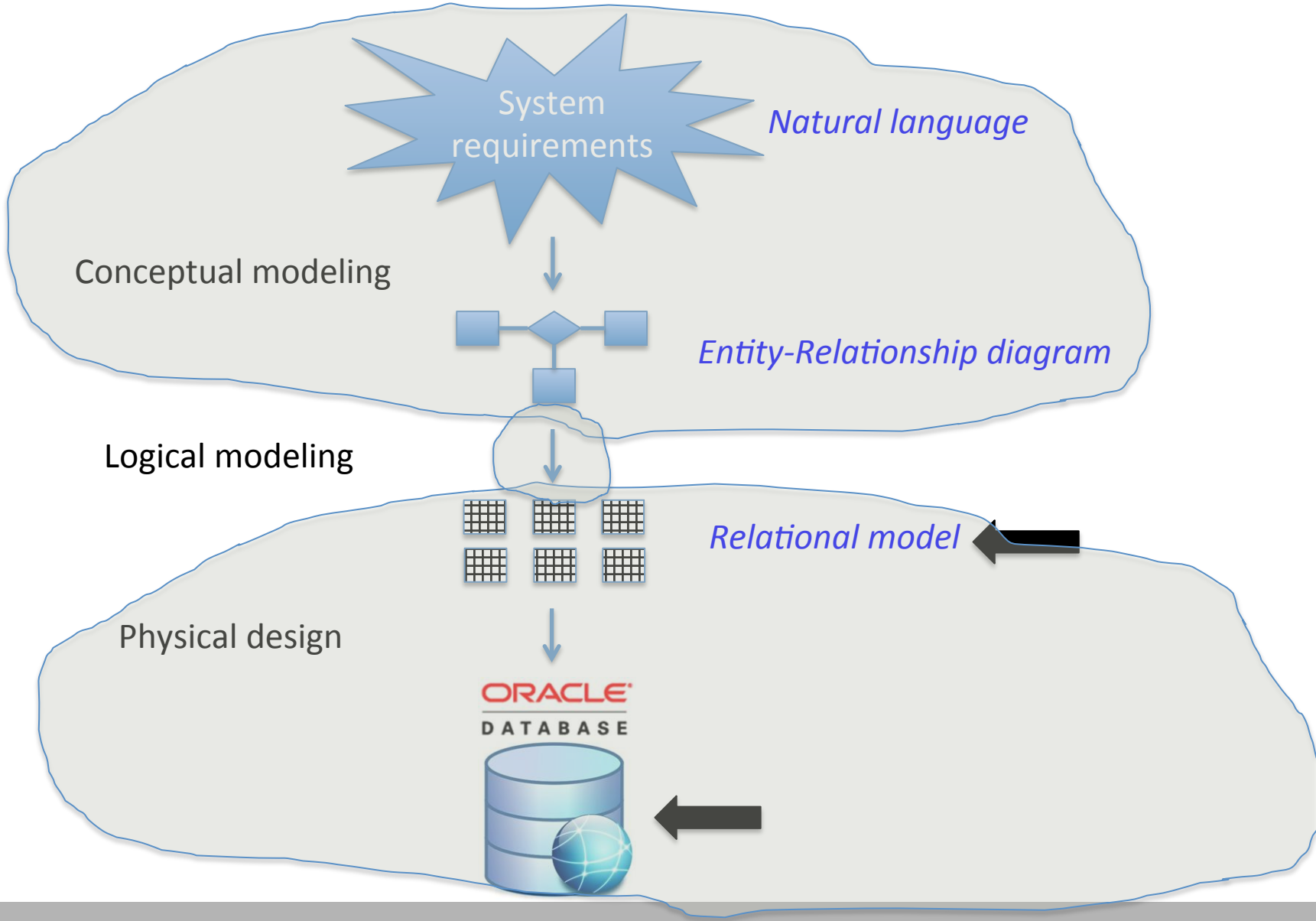
Where are we



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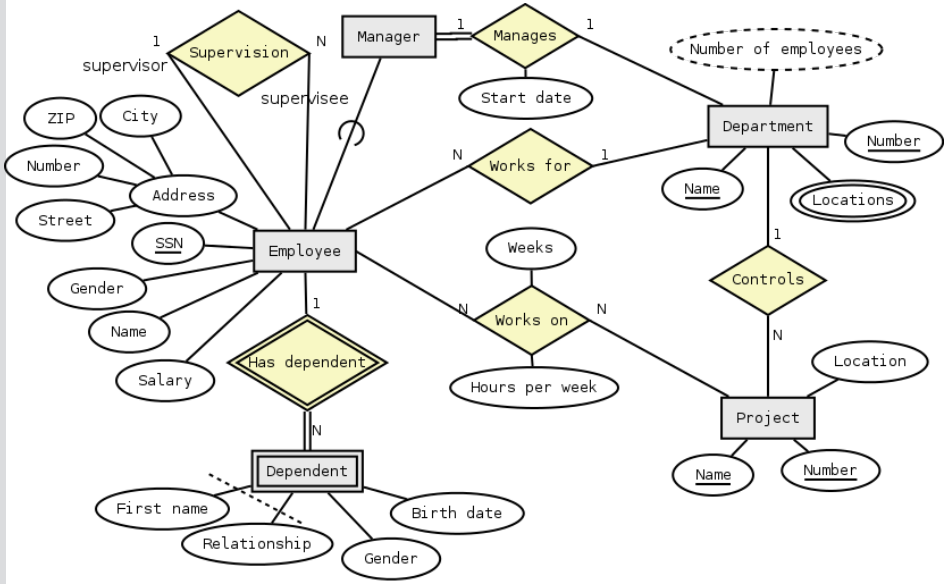
Where we are



1) Employee: aka Worker
2) e in Manager -> Sum_{forall p s.t. Works_on(e,p)}(e.Hours_per_week x e.Weeks) >= 500

TRANSLATION

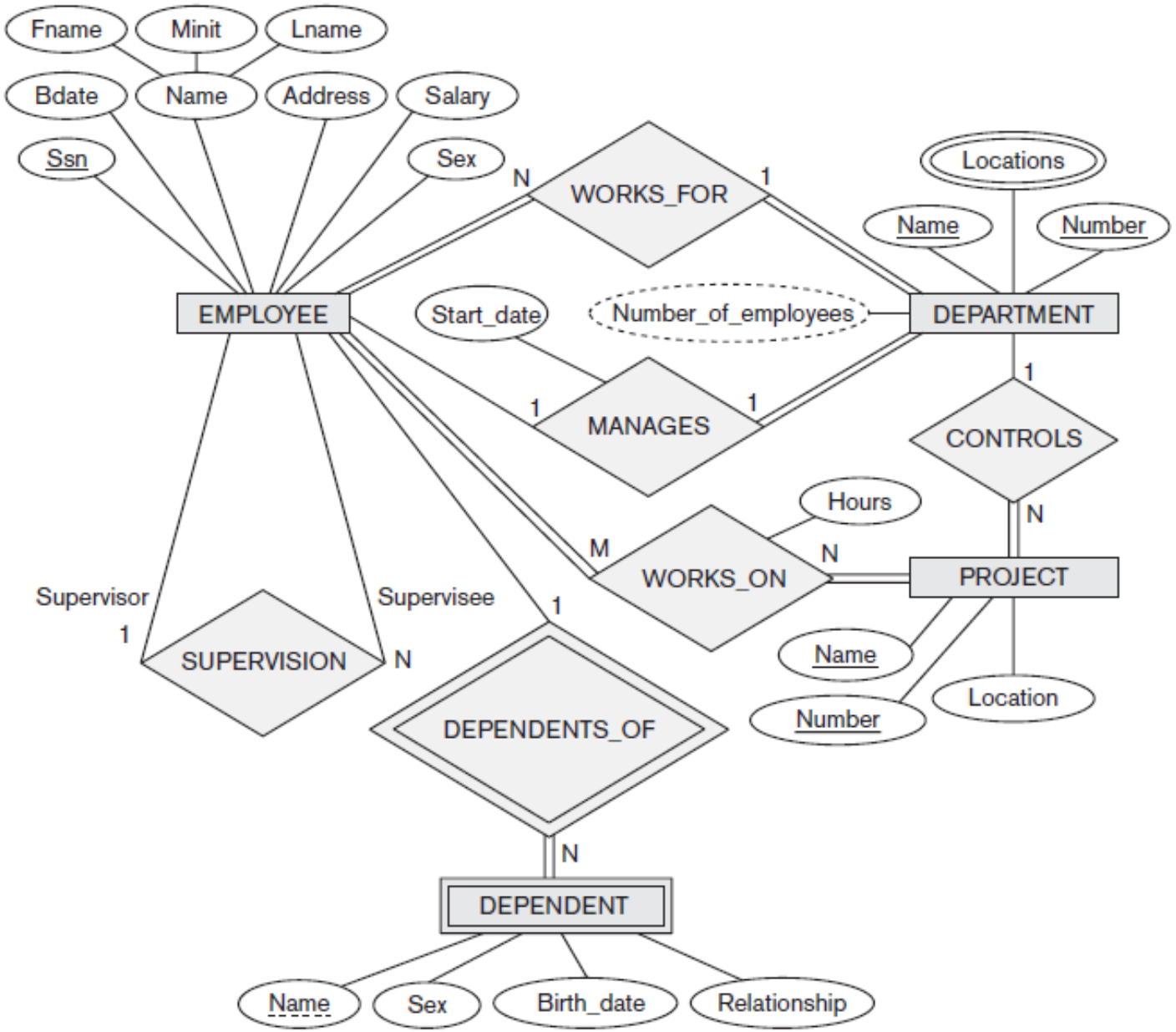
ProjectID	Manager
PR123	001
PR153	002
Pr12	003

EmpID	SSN	Name	Surname	Salary
001	18160421	Charlotte	Brontë	13 000
002	18180730	Emily	Brontë	12 500
003	18200117	Anne	Brontë	11 000

Intended Learning Outcomes

- Translate an ER diagram into a relational schema.
  - Entities, attributes, relationships.
  - Constraints.
    - cardinalities, participations, identifiers, weak entities.
  - Ternary or n-ary relationships.
  - Generalizations.

Figure 9.1
The ER conceptual schema diagram for the COMPANY database.



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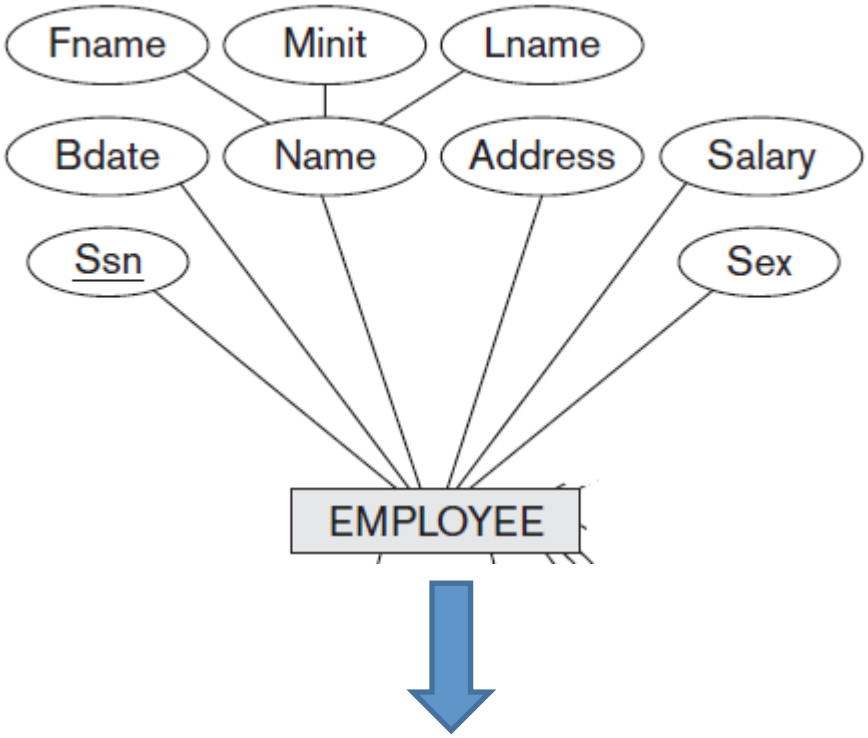
Mapping of Entity Types



EMPLOYEE

Ssn	Bdate	Fname	Minit	Lname	Address	Salary	Sex

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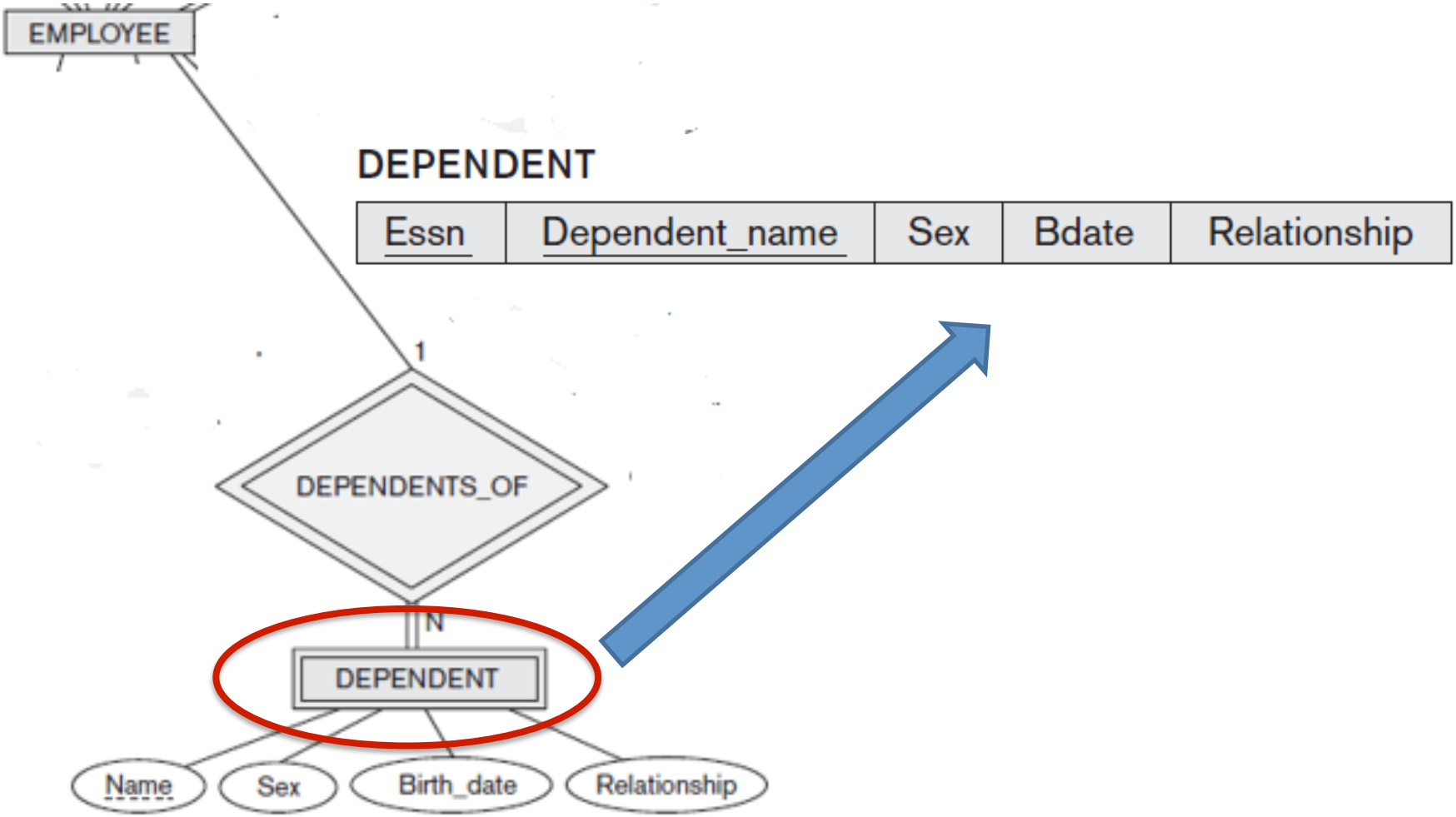
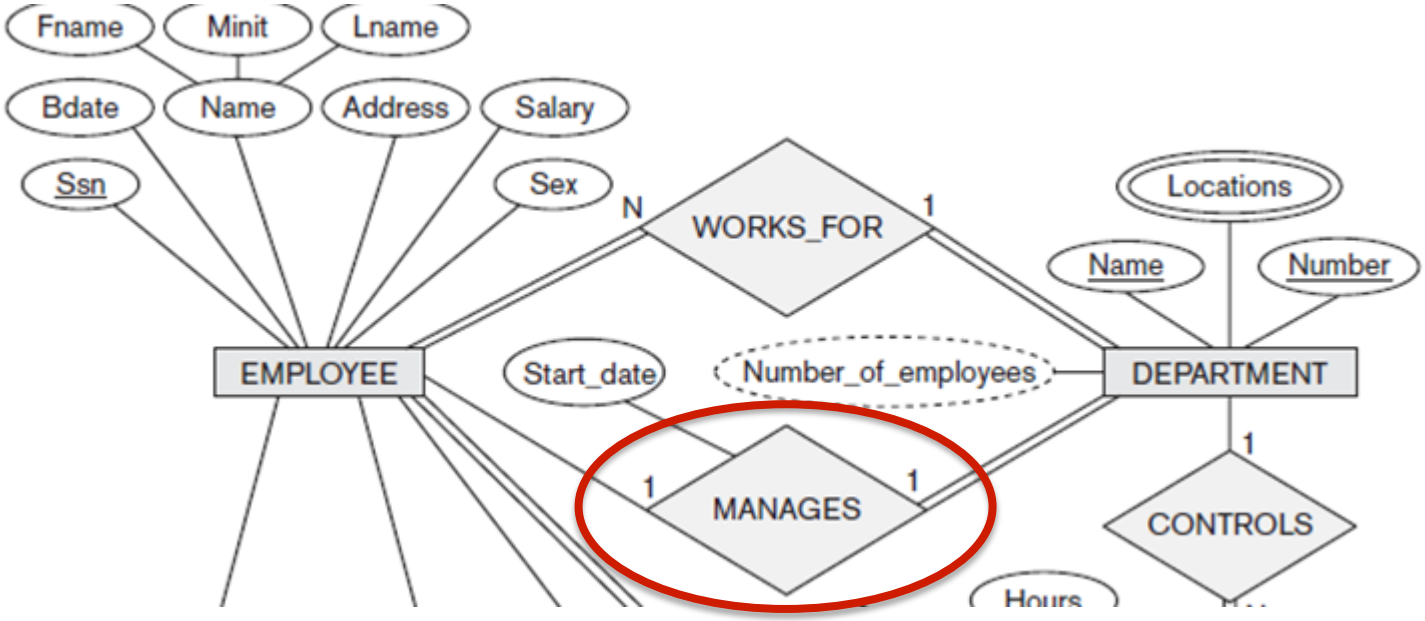
Mapping of Weak Entity Types



Mapping of Binary 1:1 Relationship Types



DEPARTMENT

Dname	Dnumber	Mgr_ssn	Mgr_start_date

NOT NULL

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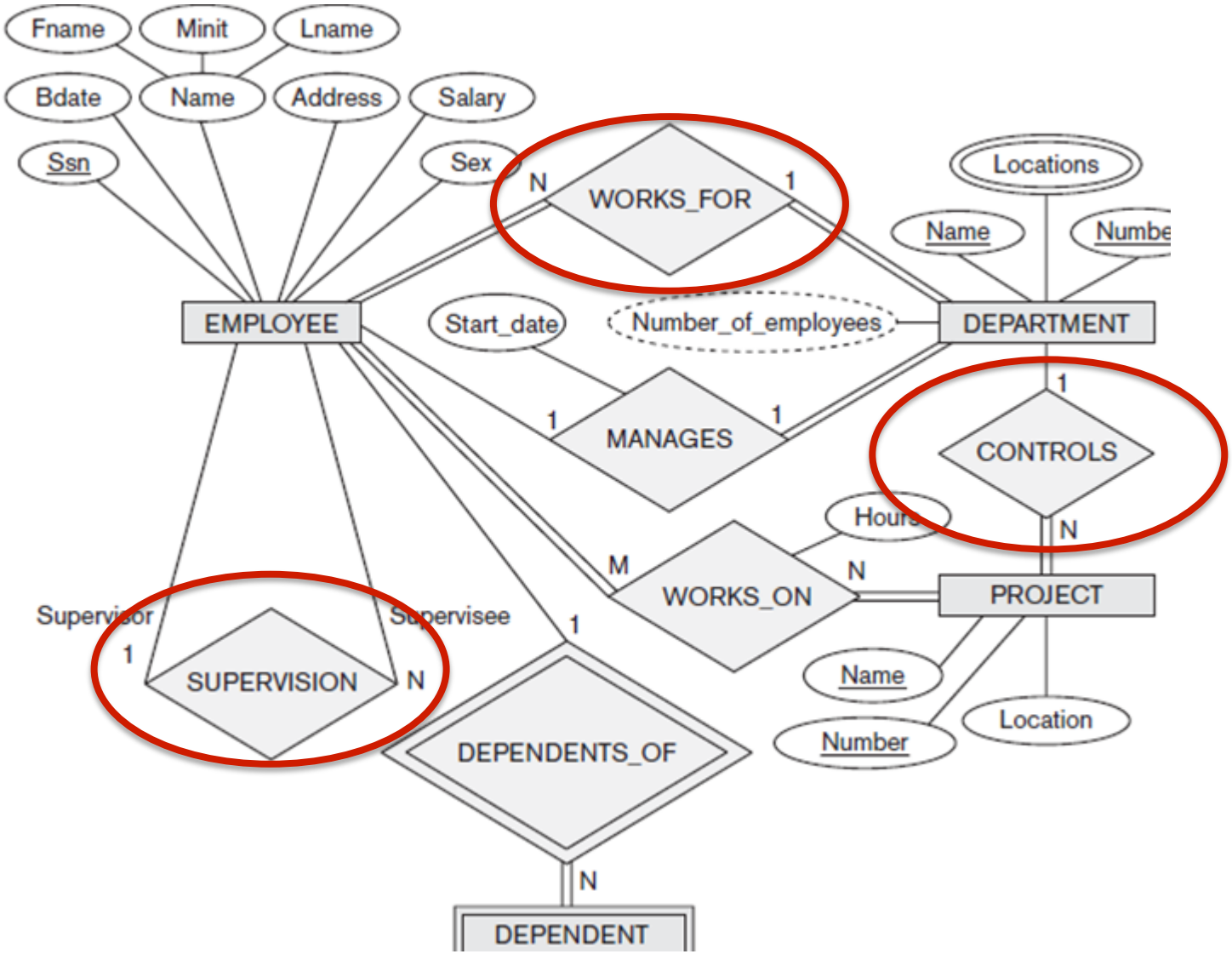
Mapping of Binary 1:N Relationship Types



Mapping of Binary 1:N Relationship Types (cont..)

- WORKS_FOR and SUPERVISION

EMPLOYEE

Fname	Minit	Lname	Ssn	Bdate	Address	Sex	Salary	Super_ssn	Dno

NOT NULL

- CONTROLS

PROJECT

Pname	Pnumber	Plocation	Dnum

NOT NULL

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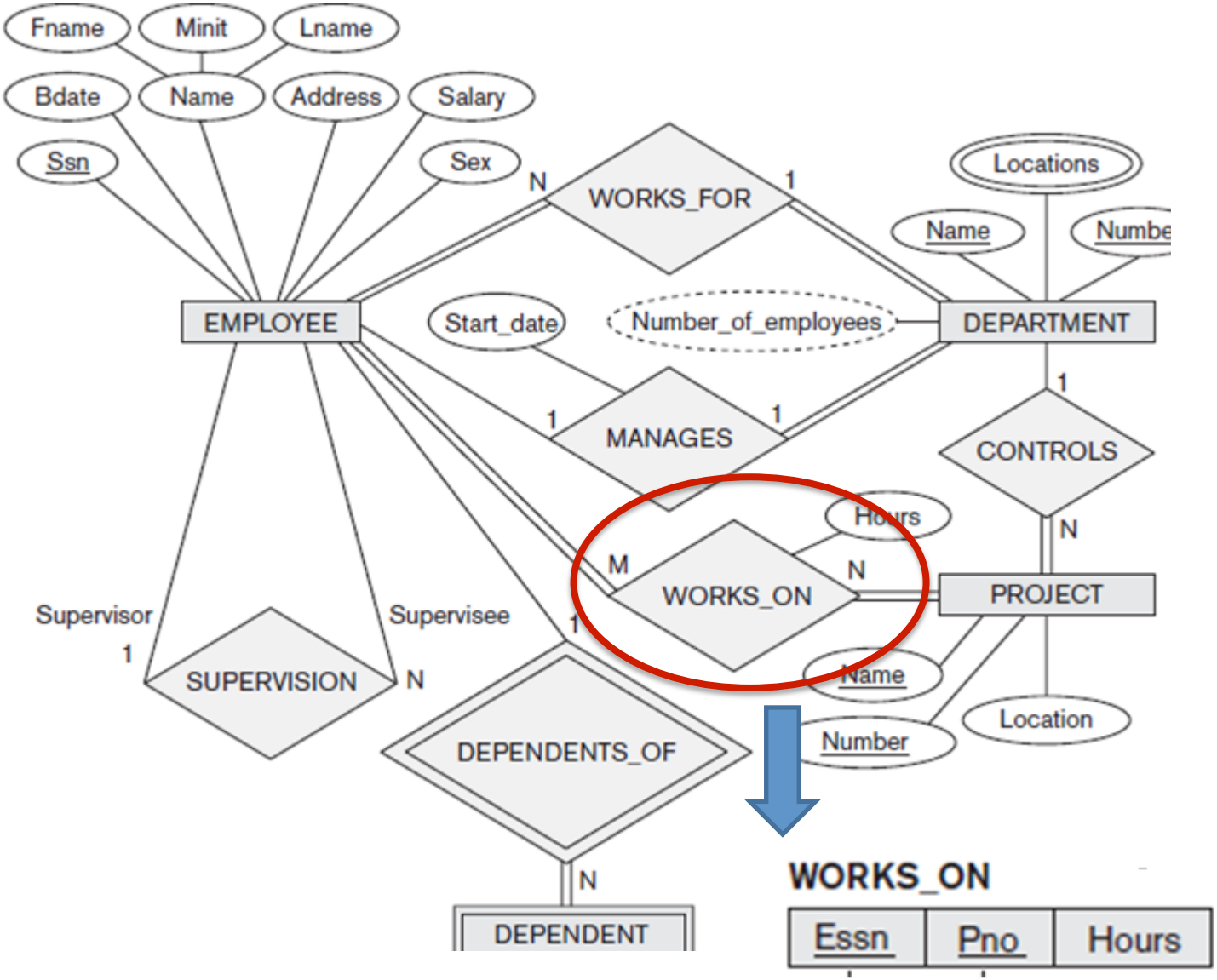
Mapping of Binary M:N Relationship Types



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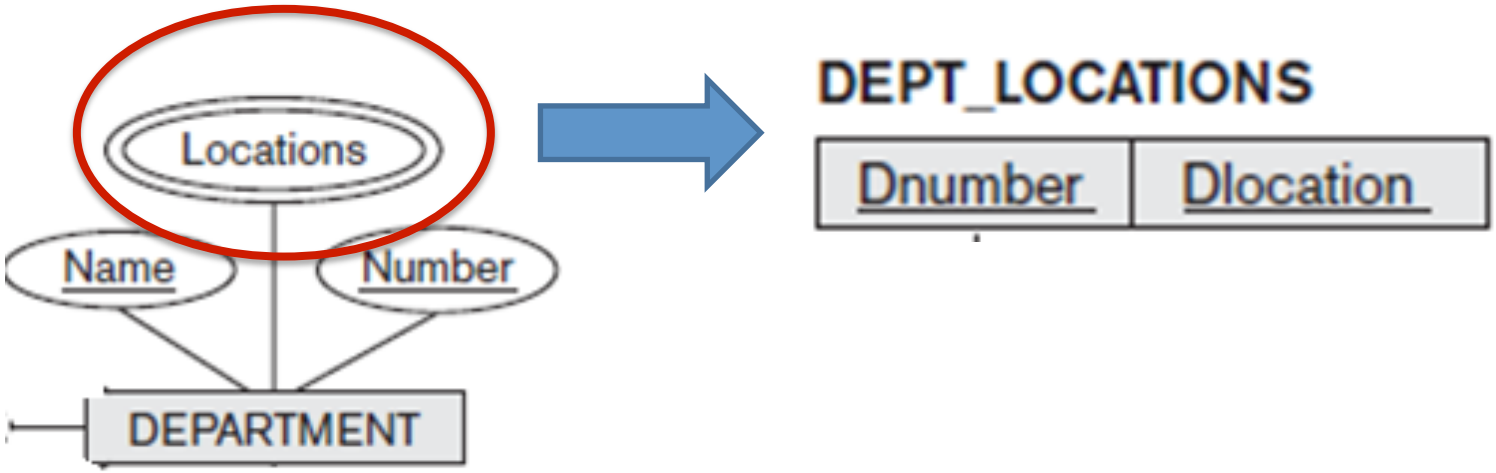
Mapping of Multivalued Attributes



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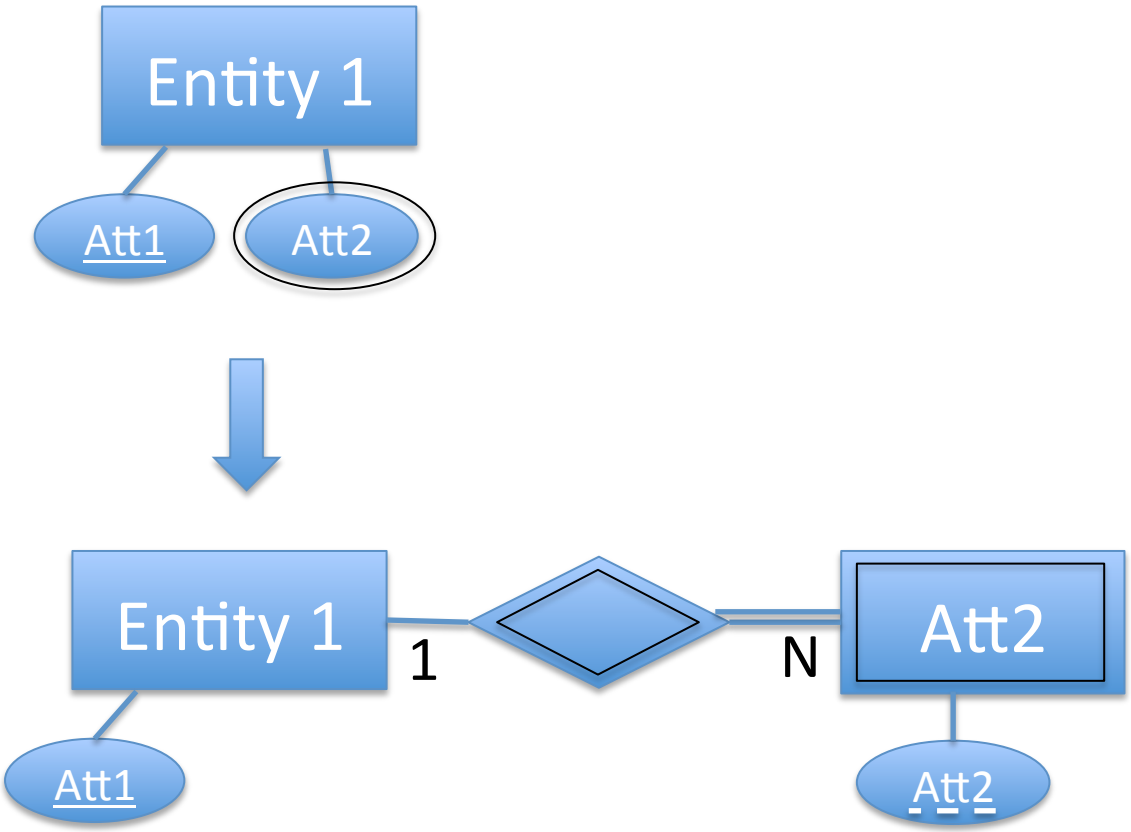
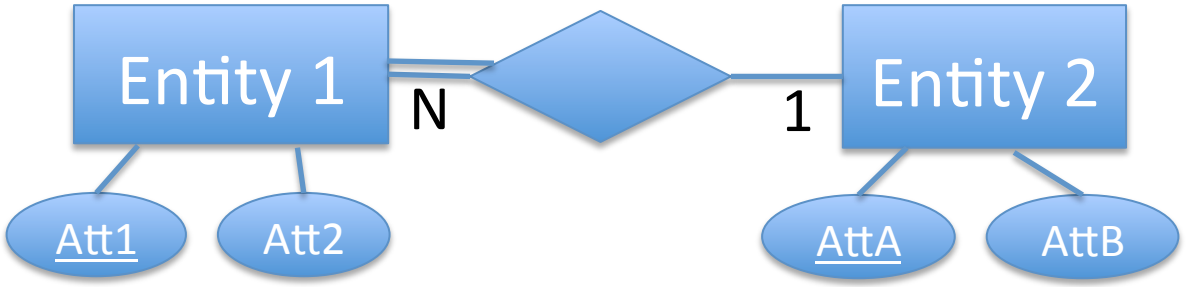
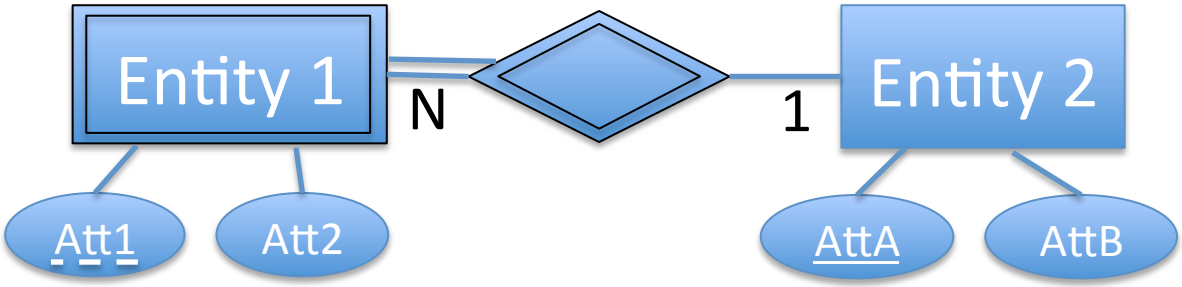
Mapping of Multivalued Attributes (cont.)



Task: translate the following two cases





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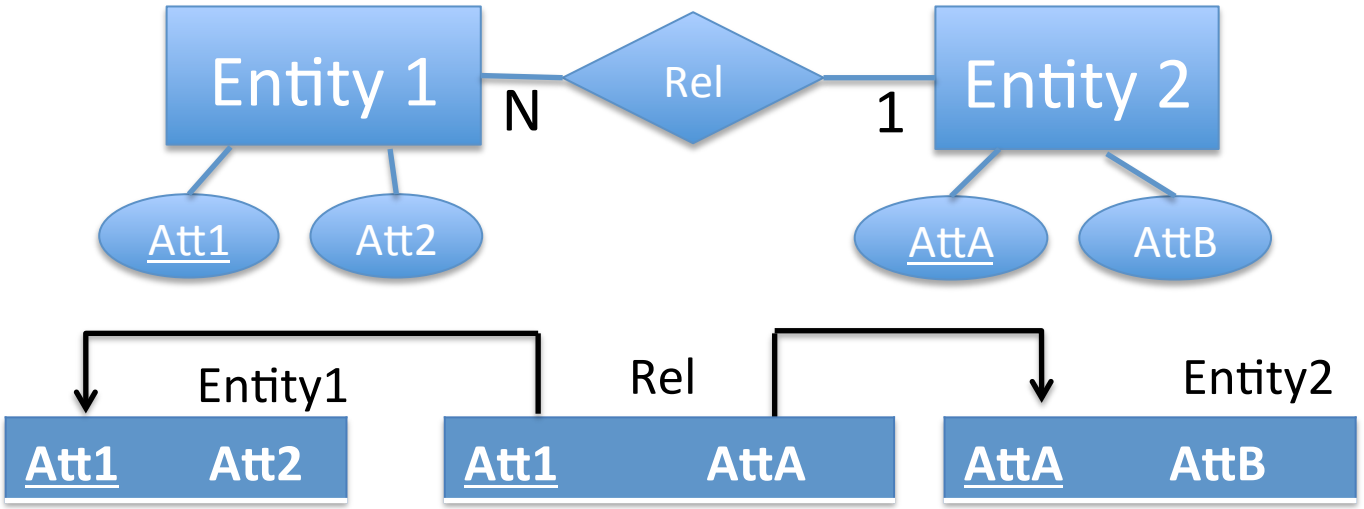
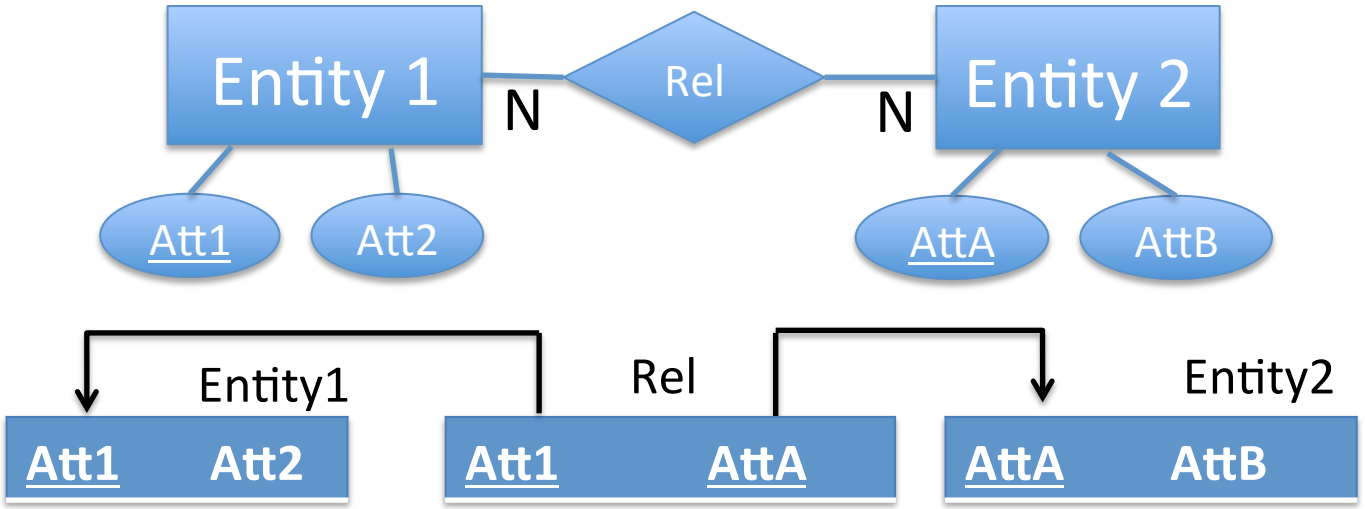
Task: translate the following using 3 relations





Summary

- Entities become relations.
- We choose an identifier as primary key.
  - It can involve more than one attribute.
- The relationship becomes a foreign key, inserted to the N-side relation.
- In case of one-to-one relationships, the foreign key can be added to any of two relations.
  - Preferably where participations are total.

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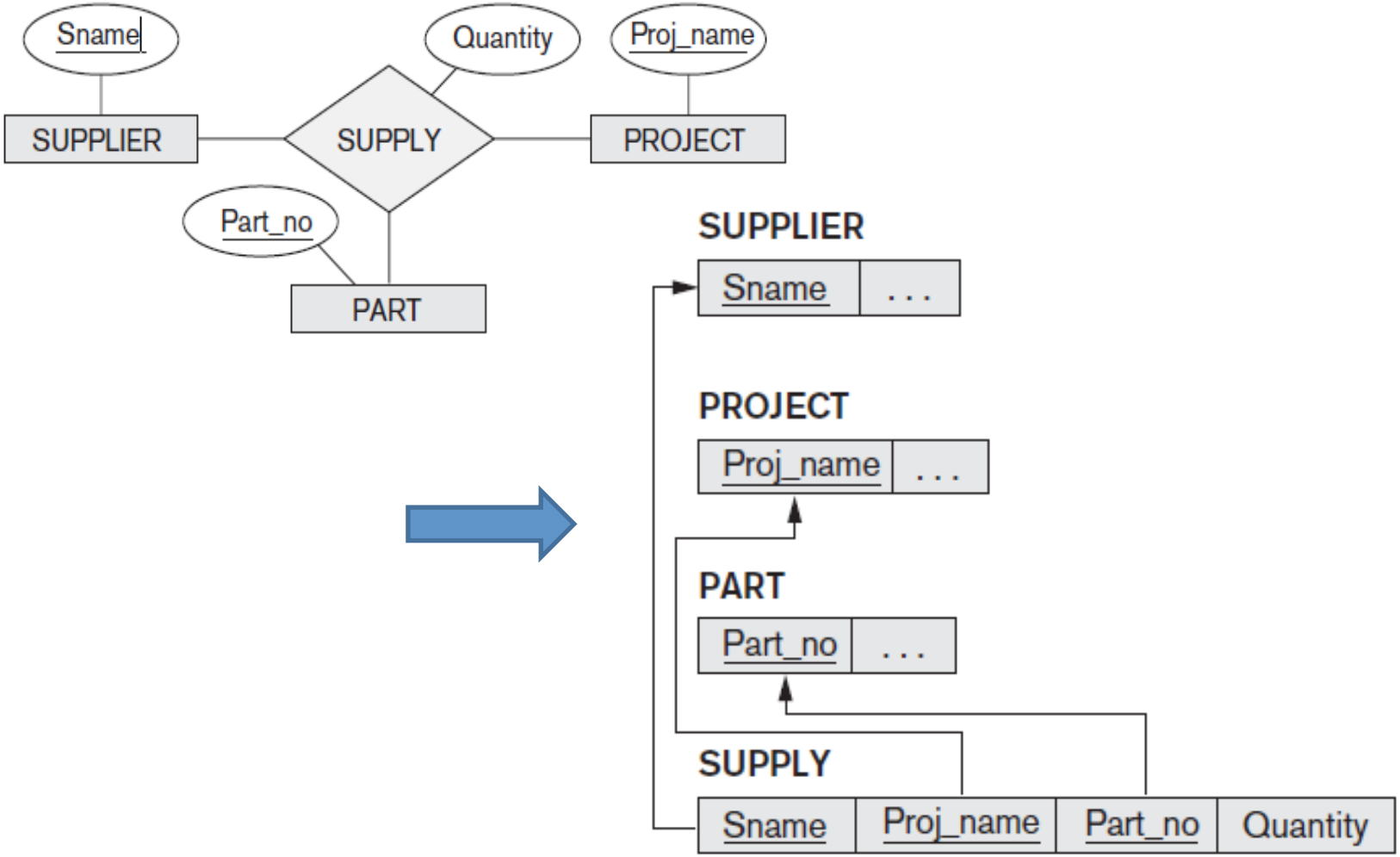
Summary(cont.)

- Weak entity type -> Relation.
  - Use the weak identifier + the identifier of the identifying entity type as primary key.
- One-to-many relationship:
  1. -> Foreign key (i.e., additional attribute/column).
  2. -> Relation, two foreign keys, primary key of the entity to the N side.
- Many-to-many relationship -> as case 2. above.
  - but both foreign keys form the primary key.
- Total participations result in NOT NULL constraints.

Mapping of N-ary Relationship Types (cont.)



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Summary (ER to relational)

Table 9.1 Correspondence between ER and Relational Models

ER MODEL	RELATIONAL MODEL
Entity type	*Entity* relation
1:1 or 1:N relationship type	Foreign key (or *relationship* relation)
M:N relationship type	*Relationship* relation and *two* foreign keys
n-ary relationship type	*Relationship* relation and *n* foreign keys
Simple attribute	Attribute
Composite attribute	Set of simple component attributes
Multivalued attribute	Relation and foreign key
Value set	Domain
Key attribute	Primary (or secondary) key

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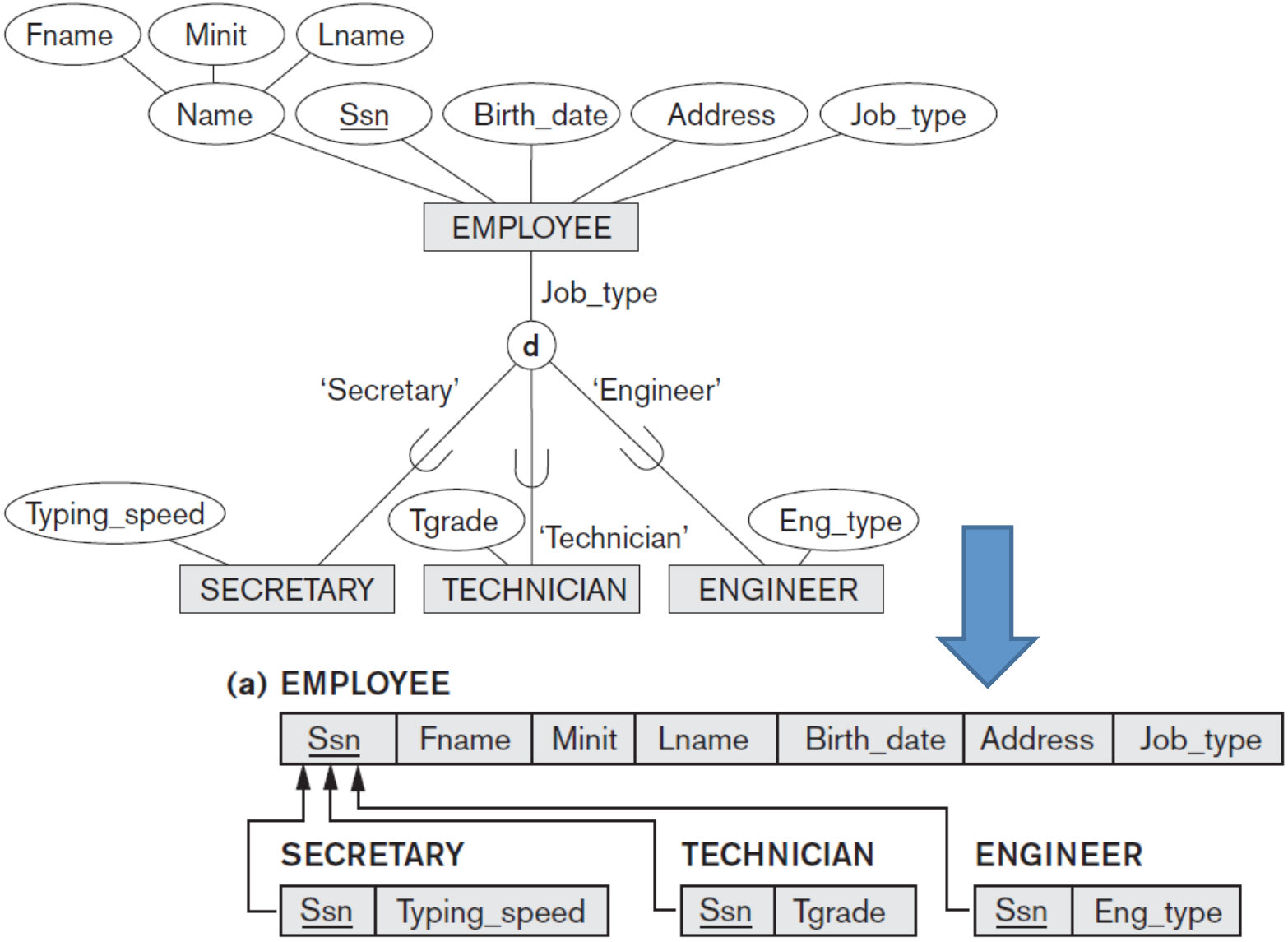
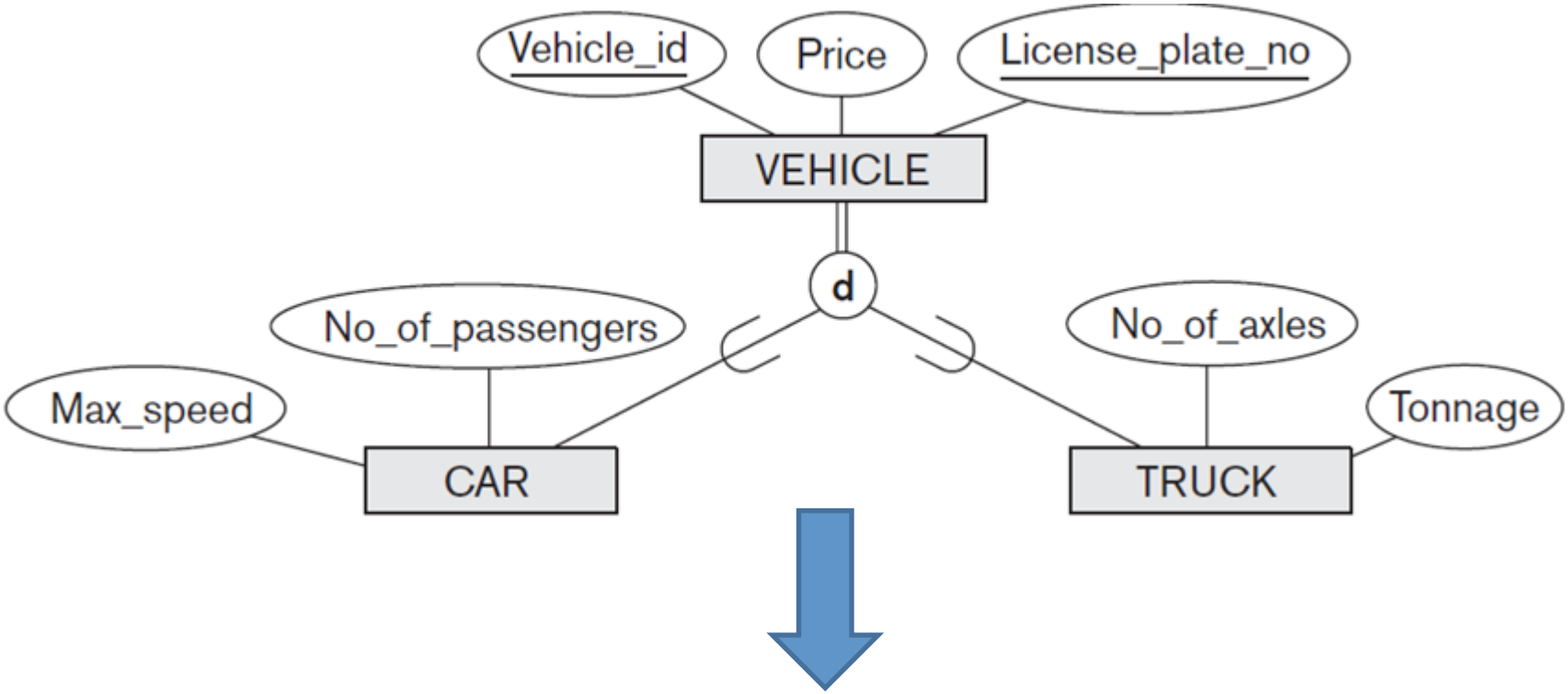
Mapping EER Model Constructs to Relations

- Multiple relations—superclass and subclasses.
- Multiple relations—subclass relations only.
- Single relation with one type attribute.
- Single relation with multiple type attributes.

Multiple relations—superclass and subclasses



Multiple relations—subclass relations only



CAR

Vehicle_id	License_plate_no	Price	Max_speed	No_of_passengers

TRUCK

Vehicle_id	License_plate_no	Price	No_of_axles	Tonnage

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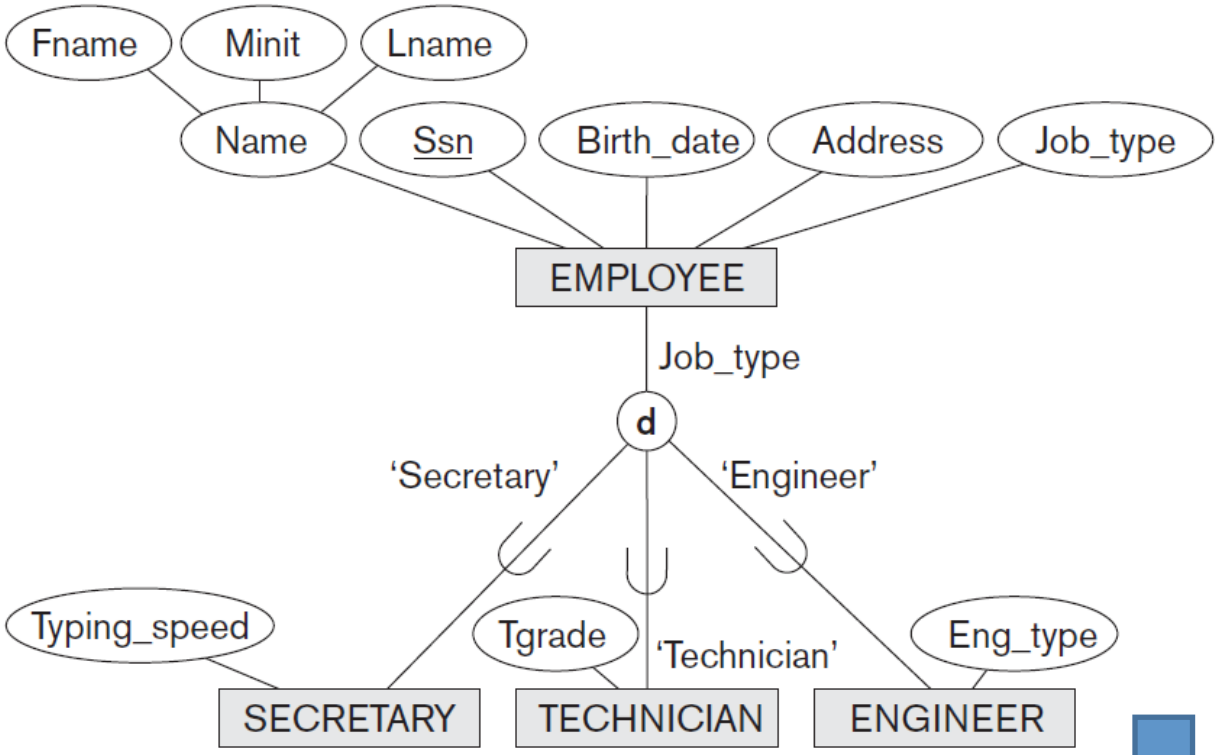
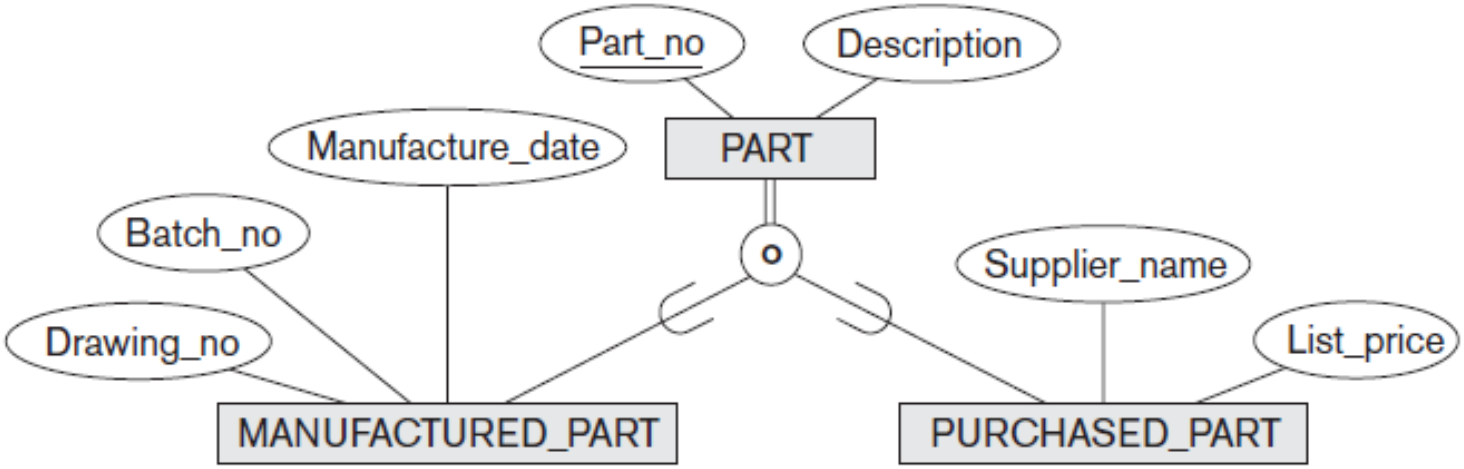
Single relation with one type attribute



EMPLOYEE

Ssn	Fname	Minit	Lname	Birth_date	Address	Job_type	Typing_speed	Tgrade	Eng_type

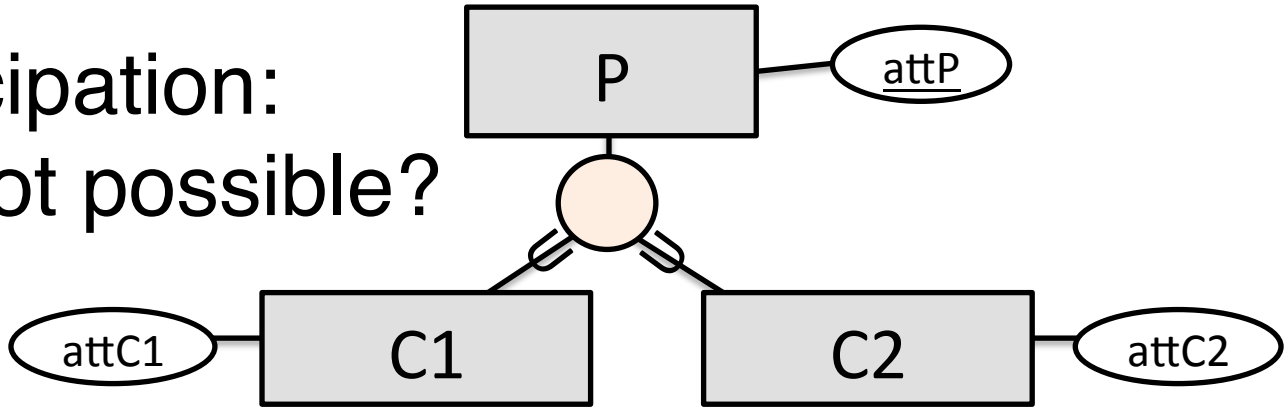
Single relation with multiple type attributes



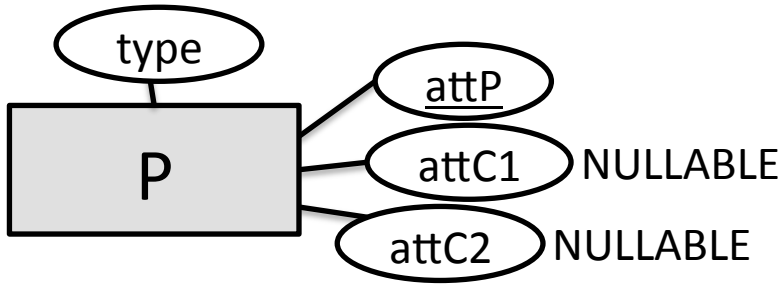
PART

Part_no	Description	Mflag	Drawing_no	Manufacture_date	Batch_no	Pflag	Supplier_name	List_price

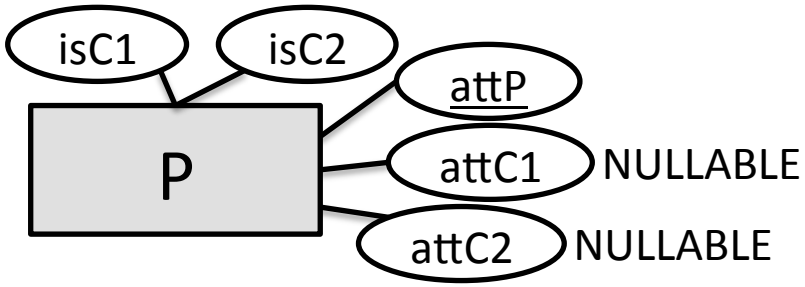
Partial participation: which one not possible?



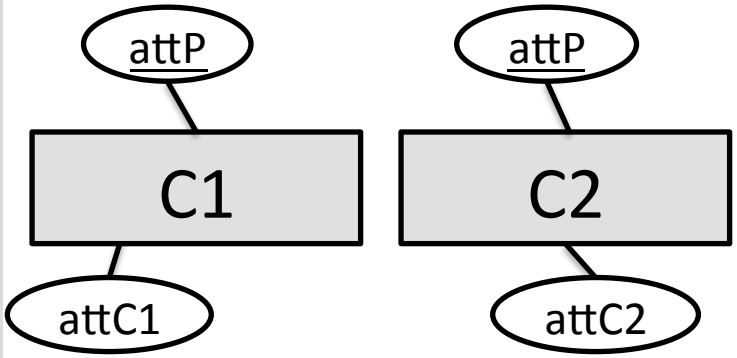
A)



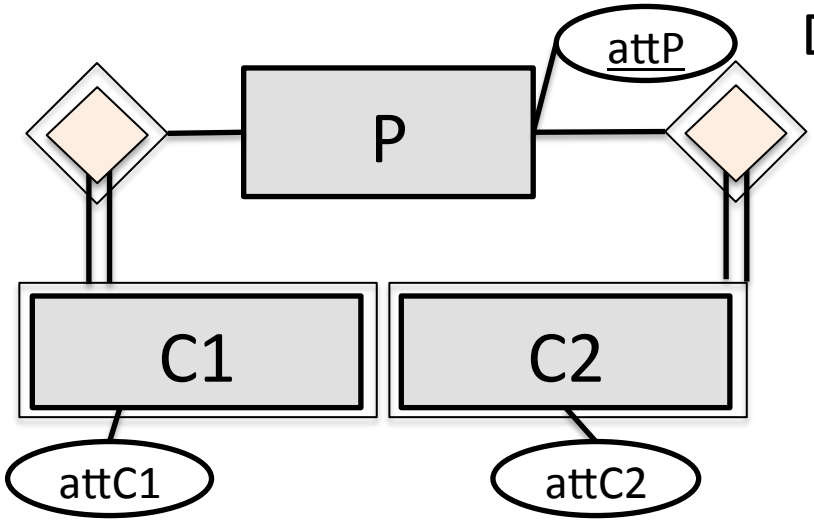
B)



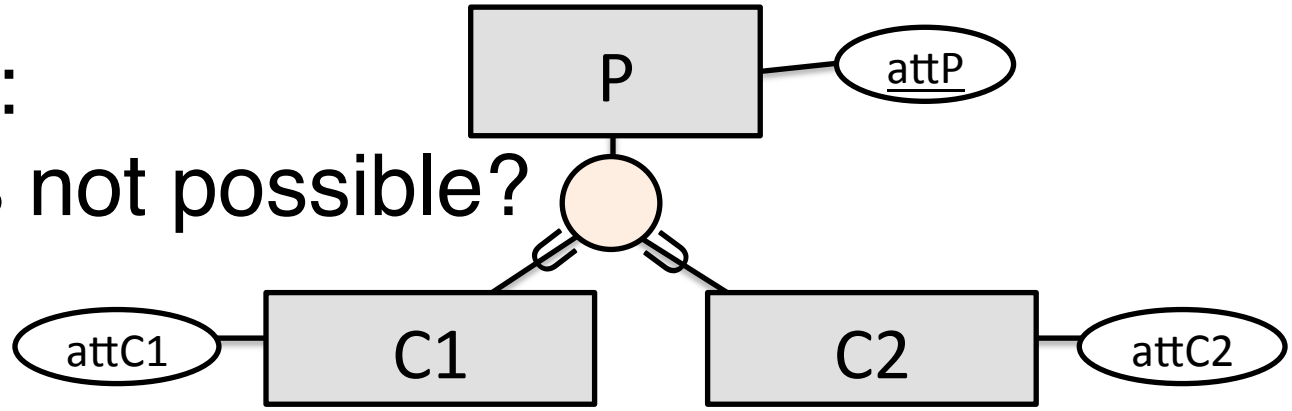
C)



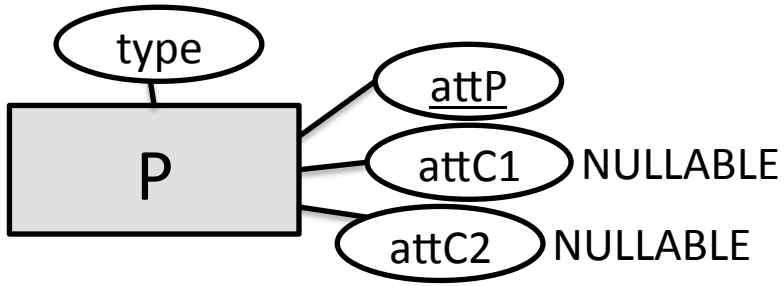
D)



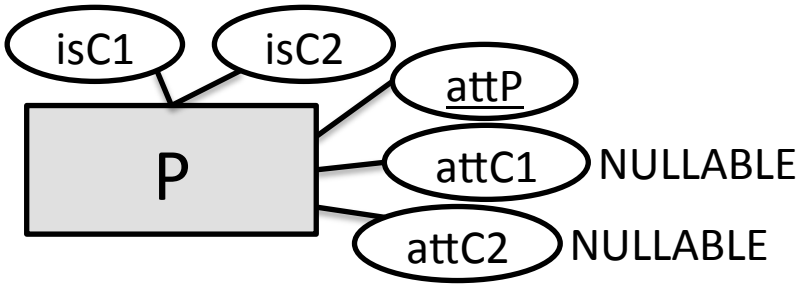
Overlapping: which one is not possible?



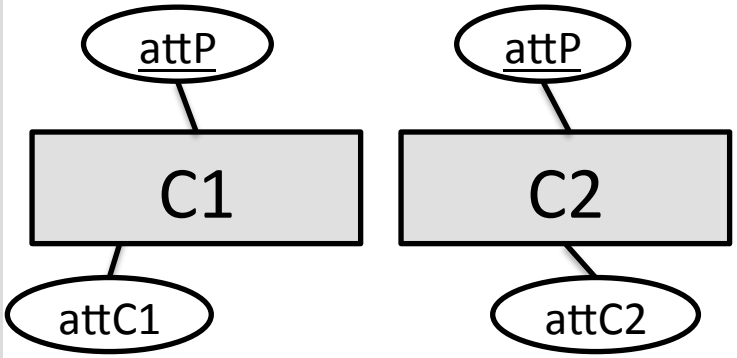
A)



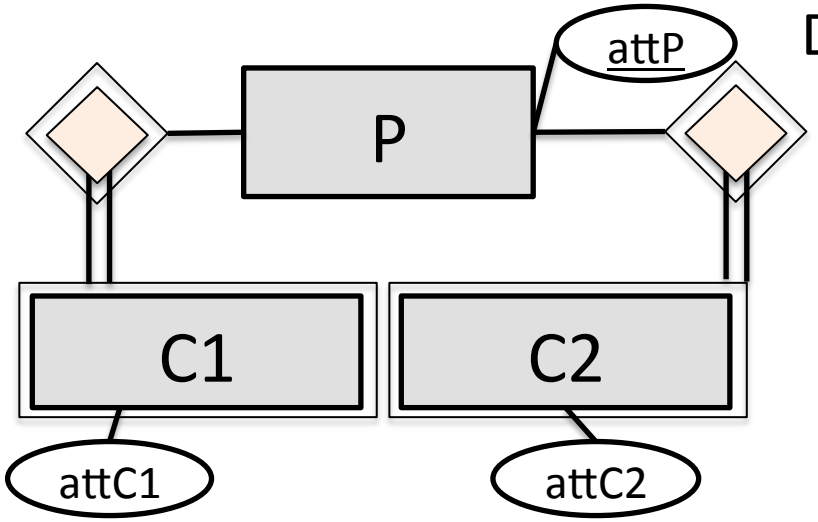
B)



C)



D)



Final relational schema

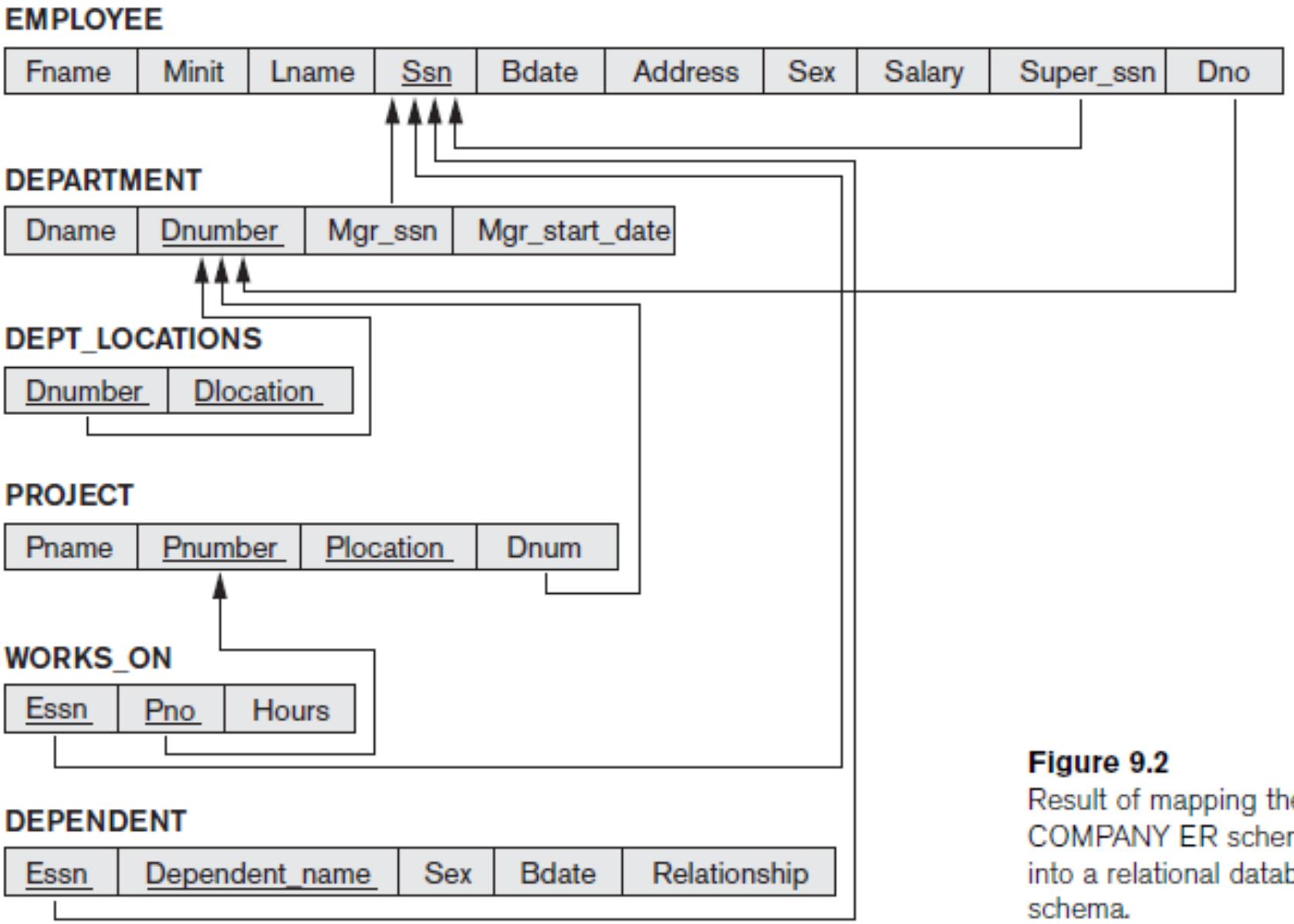


Figure 9.2
Result of mapping the COMPANY ER schema into a relational database schema.

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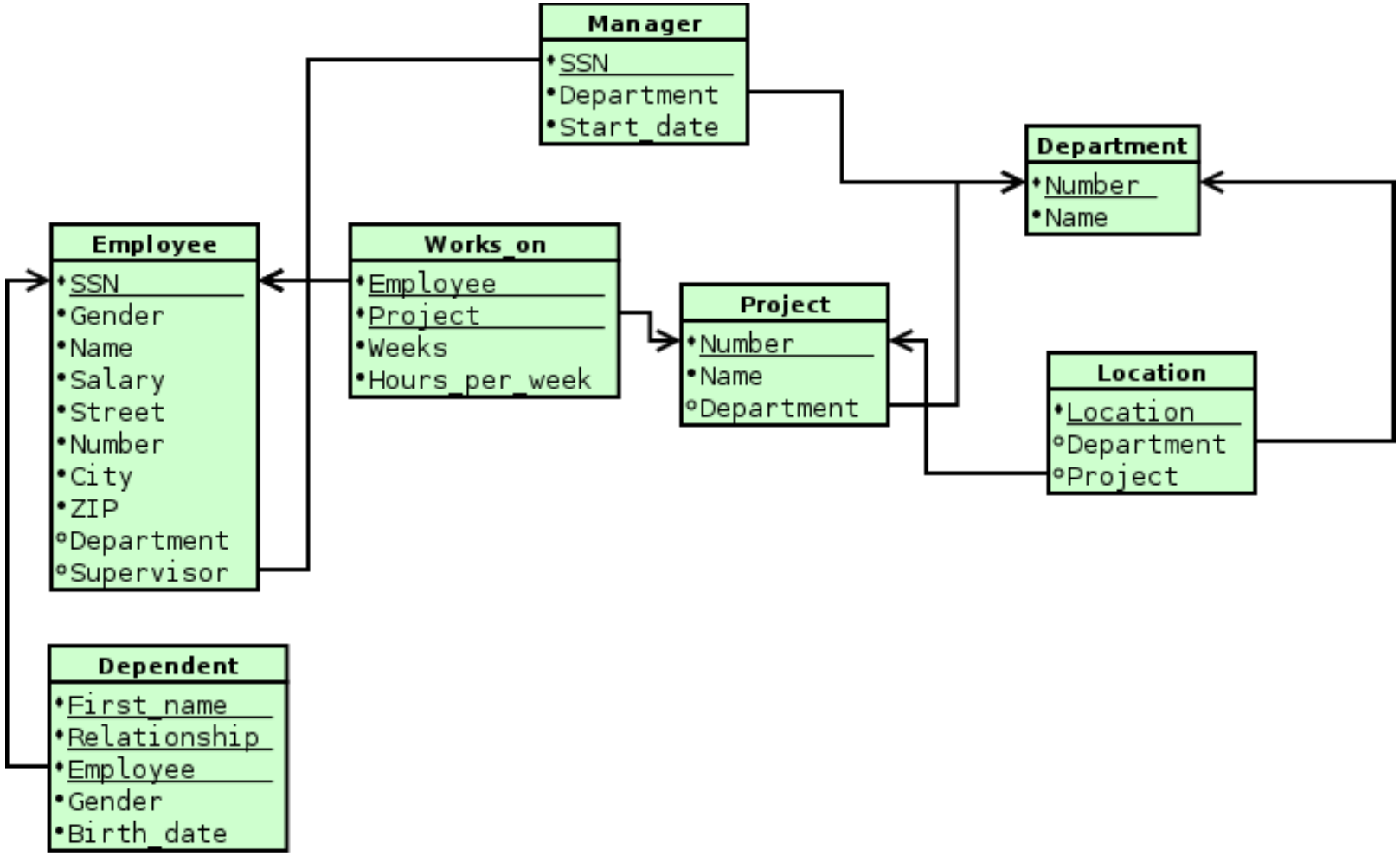
Final relational schema



1) Employee: aka Worker

2) e in Manager -> 'SELECT SUM(Weeks*Hours_per_week) FROM Works_on WHERE e.SSN = Employee' must be >= 500

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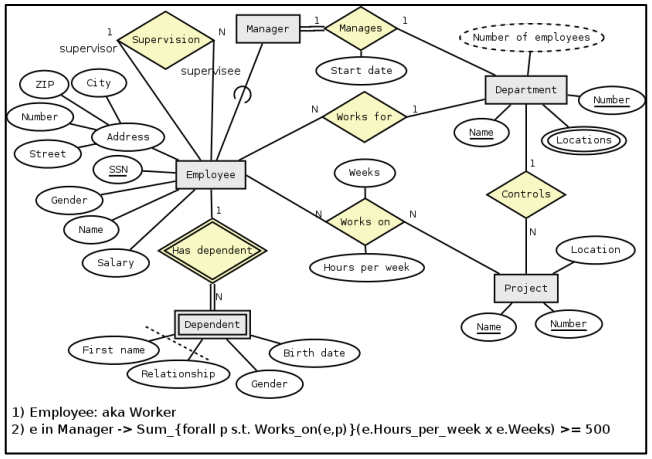
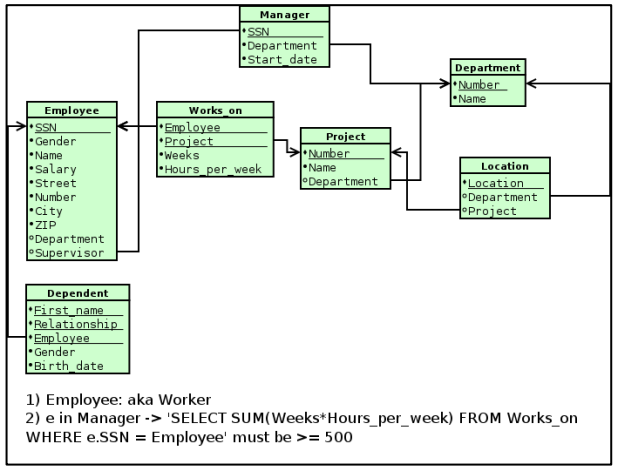
An enterprise consists of a number of departments. Each department has a name, a number, a manager, and a number of employees. The starting date for every department manager should also be registered. A department can have several locations. Every department controls a number of projects. Each project has a unique name, a unique number (both unique only inside the project's department) and a location. For each employee, the following information is kept: name, social security number, address, salary and sex. An employee works for only one department but can work with several projects that can be related to different departments. An employee may also supervise one or more other workers. Information about the number of hours (per week) that an employee works with each project should be stored – to be a manager one must have worked at least 500 hours on projects. We also want to keep track of the dependents of each employee, for insurance purposes. We keep each dependent's first name, sex, birth date and relationship to the worker.





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ER to relational – exercise part 1

- The owners of a real estate agency want to digitalize their paper archive, to reduce their environmental impact. To allow the efficient extraction of information about the properties managed by the agency, they have decided to build a relational database and asked you to design it, using the ER model and according to the following requirements:
- Ⓟ For each property, we need to know the extension of its land (expressed in square meters), a unique property identifier, and some text with a general description.
- Ⓟ Each property belongs to one or more provinces. For each province we want to store its name, population, and a general description.
- Ⓟ Each property contains zero, one or more buildings.
- Ⓟ Each building has a unique identifier and can be of different types: a "villa" (in which case we want to store its name, e.g., "Villa Magnana"), an "apartment block" (in which case we want to store the number of apartments) or "other" (in which case we want to have a textual description of the building). No other types of building are possible.

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ER to relational – exercise part 2

- (For the following tasks, please draw a separate EER diagram)
- Modify the previous solution so that the identifier of the buildings is no longer globally unique, but is only unique with respect to the property to which it belongs.
- In case a property belongs to more than one region, we want to store the percentage of the property present in each of them (the sum of these percentages for each property must be 100).
- A province can be administratively dependent on another.
- No province can have more than three other provinces depending on it.

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ER to relational – exercise part 3

- Consider the previous diagrams.
- Ⓟ Translate it to a relational model schema (i.e., indicate the relations and their attributes).
- Indicate all the primary keys.
- Indicate all the foreign keys, if any.
- Indicate all the attributes that allow NULL values, if any.
- Indicate all the UNIQUE (sets of) attributes that are not part of a primary key, if any.