

CS254 Database Management Systems Lec05

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Important features of ER (schema) Diagram: keywords

1. Weak Entity and identifying relationship
2. Entity: Type, instance, domain, simple-composite, multivalued, stored-derived
3. Key attribute
4. Relationship: type, instance, degree(binary/ternary), multiplicity, identifying
5. Relationship attribute: ...
6. Role in a binary relationship
7. Cardinality ratio: 1:1, 1:N, N:1, M:N
8. Participation constraint: total, partial, alternate min-max notation
9. Conversion between Entity type and Relationship types

Entity types and instances (entity sets)

Entity Type Name:

EMPLOYEE

COMPANY

Name, Age, Salary

Name, Headquarters, President

Entity Set:
(Extension)

e_1 •

(John Smith, 55, 80k)

e_2 •

(Fred Brown, 40, 30K)

e_3 •

(Judy Clark, 25, 20K)

⋮

c_1 •

(Sunco Oil, Houston, John Smith)

c_2 •

(Fast Computer, Dallas, Bob King)

⋮

Figure 7.6

Two entity types, EMPLOYEE and COMPANY, and some member entities of each.

Entity and attributes

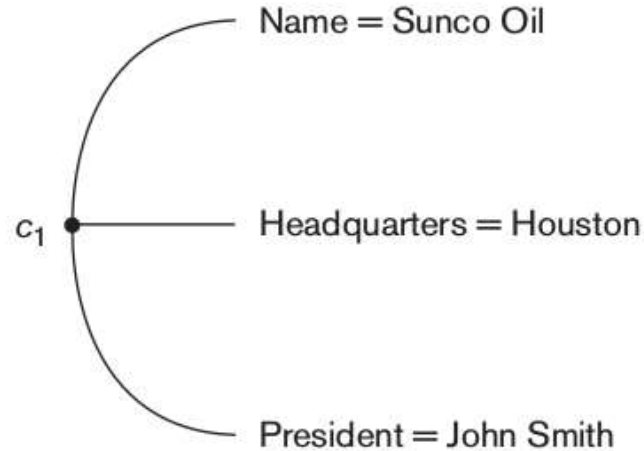
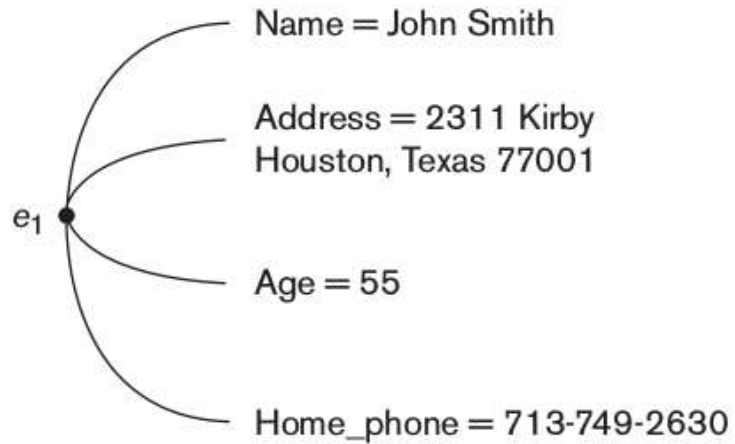


Figure 7.3

Two entities, EMPLOYEE e_1 , and COMPANY c_1 , and their attributes.

Composite attributes

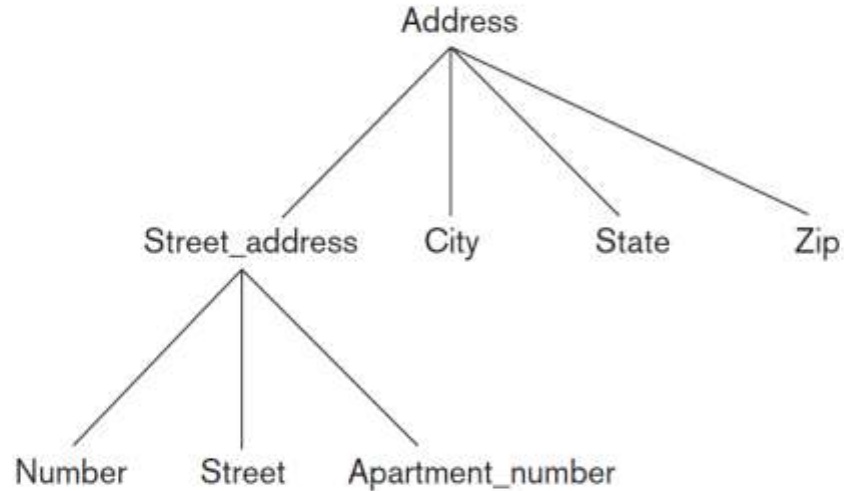


Figure 7.4

A hierarchy of composite attributes.

Different types of attributes

Single v multivalued attribute

Aadhar number (Single), telephone number (multi-valued)

Stored vs. Derived

DOB (stored), Age (Derived)

Null and Complex (Nested) Attributes

```
{Address_phone( {Phone(Area_code,Phone_number)},Address(Street_address  
(Number,Street,Apartment_number),City,State,Zip) )}
```

Figure 7.5

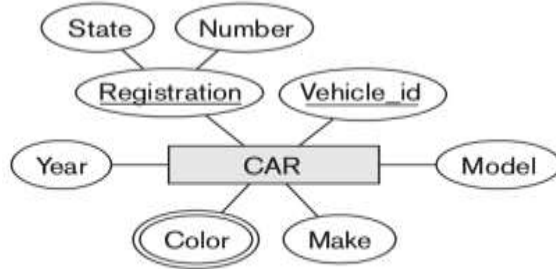
A complex attribute:
Address_phone.

Key attribute: Uniquely identifies an Entity

Figure 7.7

The CAR entity type with two key attributes, Registration and Vehicle_id. (a) ER diagram notation. (b) Entity set with three entities.

(a)



(b)

CAR
Registration (Number, State), Vehicle_id, Make, Model, Year, {Color}

CAR₁
((ABC 123, TEXAS), TK629, Ford Mustang, convertible, 2004 {red, black})

CAR₂
((ABC 123, NEW YORK), WP9872, Nissan Maxima, 4-door, 2005, {blue})

CAR₃
((VSY 720, TEXAS), TD729, Chrysler LeBaron, 4-door, 2002, {white, blue})

⋮












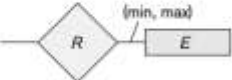
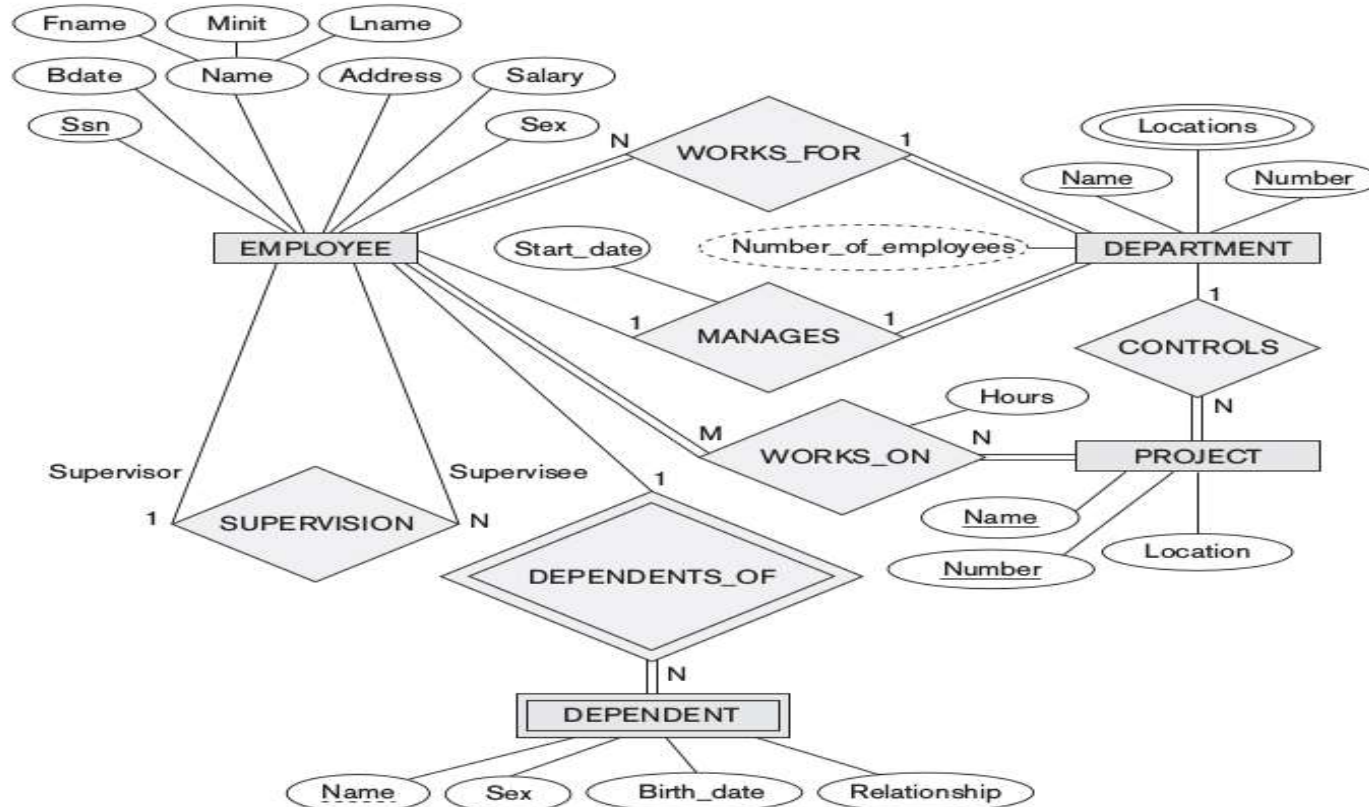
Symbol	Meaning
	Entity
	Weak Entity
	Relationship
	Identifying Relationship
	Attribute
	Key Attribute
	Multivalued Attribute
	Composite Attribute
	Derived Attribute
	Total Participation of E_2 in R
	Cardinality Ratio 1: N for $E_1:E_2$ in R
	Structural Constraint (min, max) on Participation of E in R

Figure 7.14
Summary of the notation
for ER diagrams.

Q: Why is *Number_of_employees* derived attribute?



Attribute of a Relationship

Manages

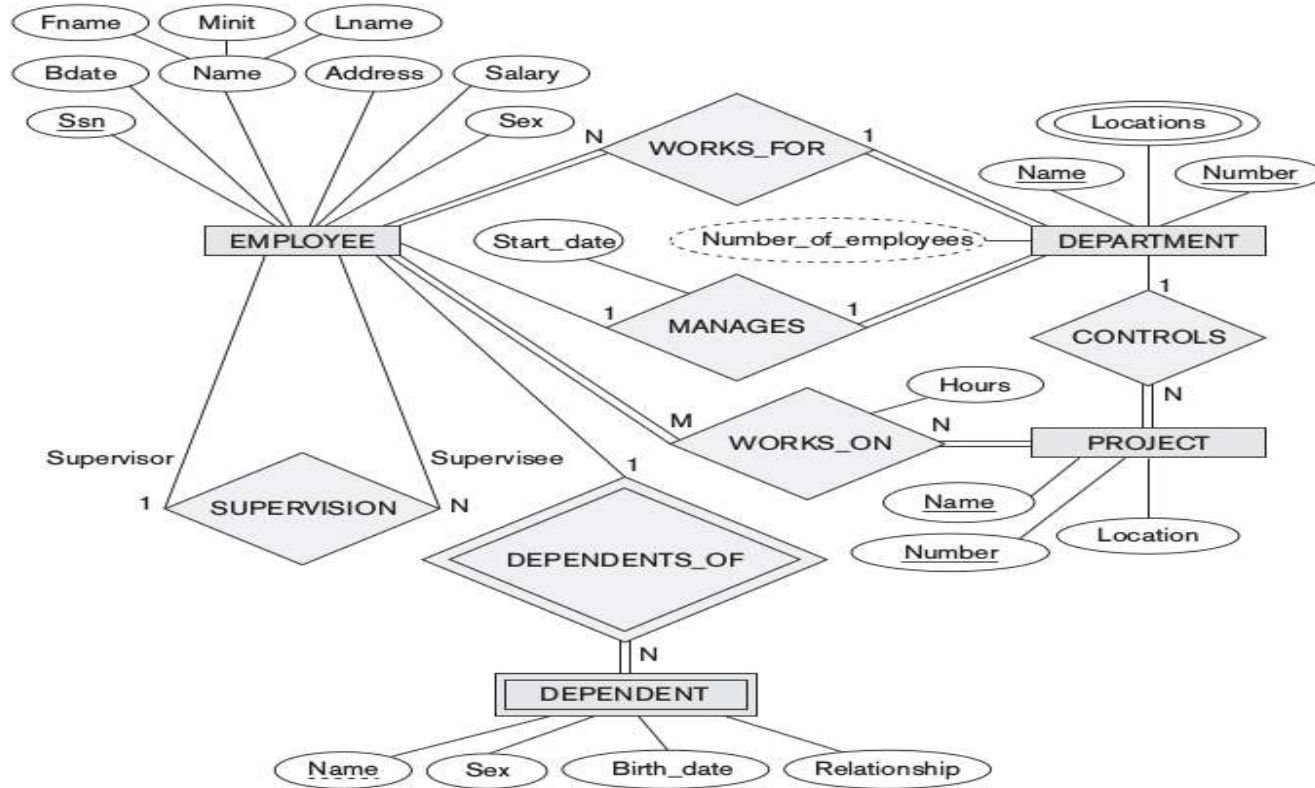
Start date, weekly tasks, Frequency of reports

Employees

Salary range, duty hours

- The company is organized into departments. Each department has a unique name, a unique number, and a particular employee who manages the department. We keep track of the start date when that employee began managing the department. A department may have several locations.
- A department controls a number of projects, each of which has a unique name, a unique number, and a single location.
- We store each employee's name, Social Security number,² address, salary, sex (gender), and birth date. An employee is assigned to one department, but may work on several projects, which are not necessarily controlled by the same department. We keep track of the current number of hours per week that an employee works on each project. We also keep track of the direct supervisor of each employee (who is another employee).
- We 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 employee.

Attribute of a Relationship: Start_date



Binary Relationship: Set Diagram

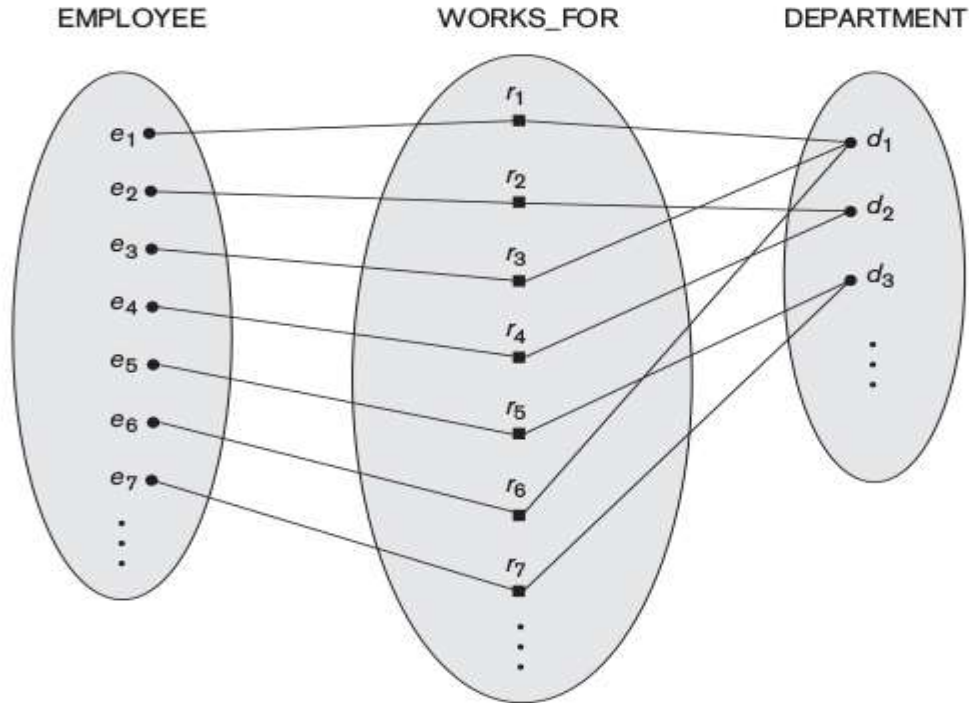


Figure 7.9

Some instances in the `WORKS_FOR` relationship set, which represents a relationship type `WORKS_FOR` between `EMPLOYEE` and `DEPARTMENT`.

Ternary Relationship: Set Diagram

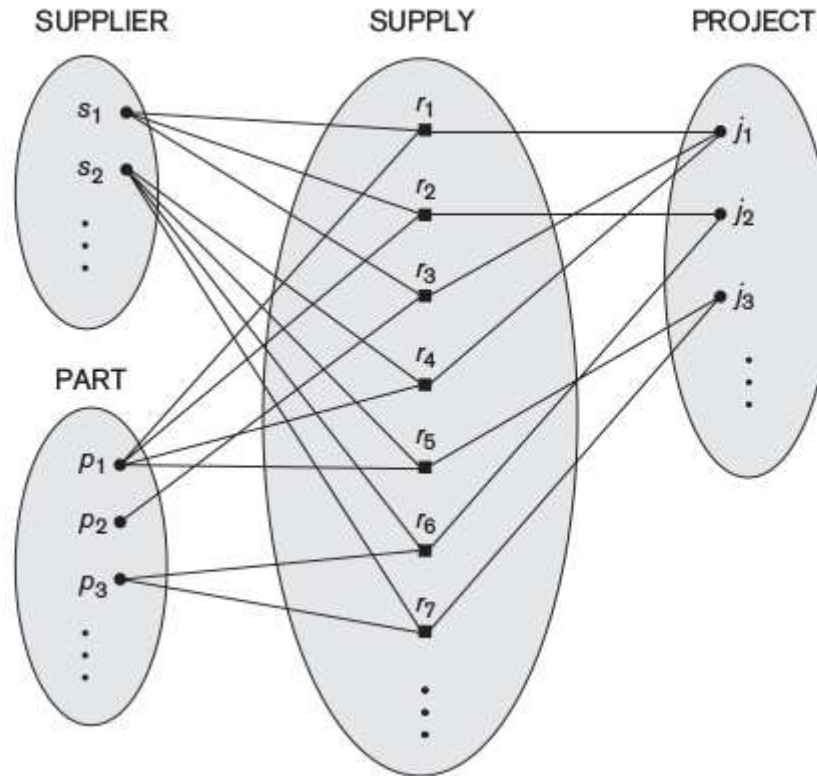


Figure 7.10

Some relationship instances in the **SUPPLY** ternary relationship set.

Role in a Binary Relationship: Set Diagram

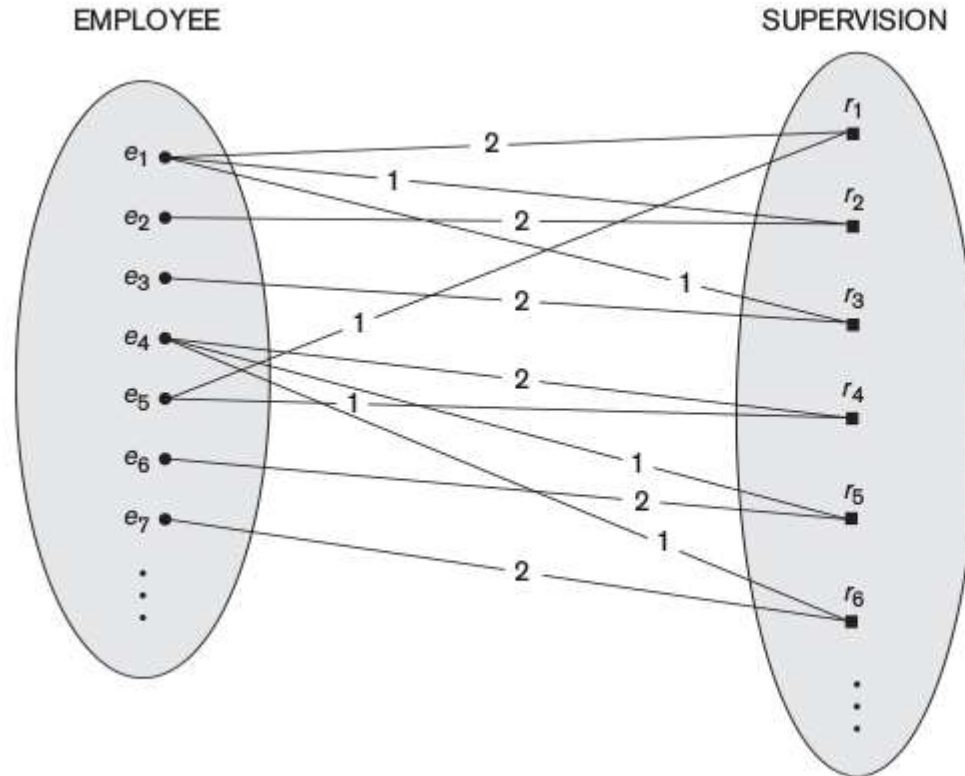


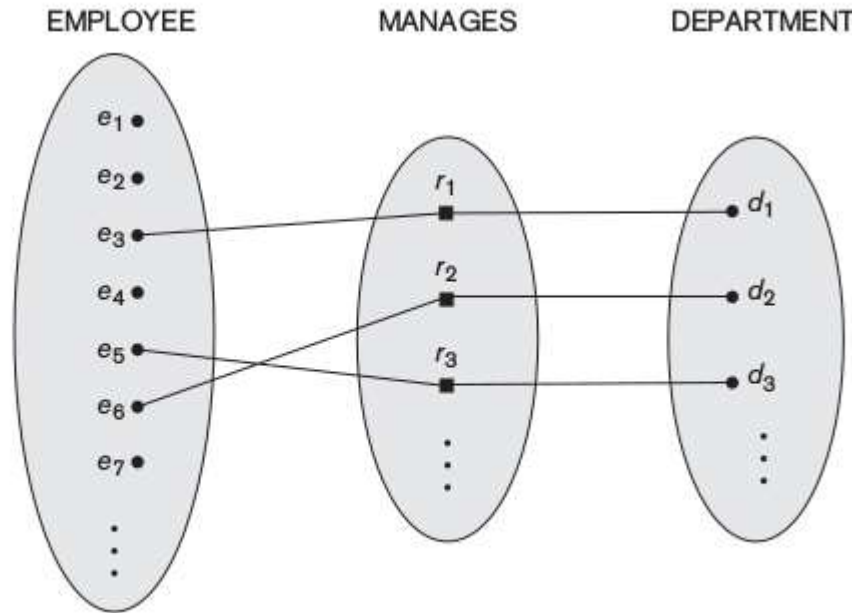
Figure 7.11

A recursive relationship SUPERVISION between EMPLOYEE in the *supervisor* role (1) and EMPLOYEE in the *subordinate* role (2).

Cardinality Ratio 1:1

Figure 7.12

A 1:1 relationship,
MANAGES.



⁹N stands for *any number* of related entities (zero or more).

Cardinality Ratio M:N

7.7 Relationship Types, Relationship Sets, Roles, and Structural Constraints 417

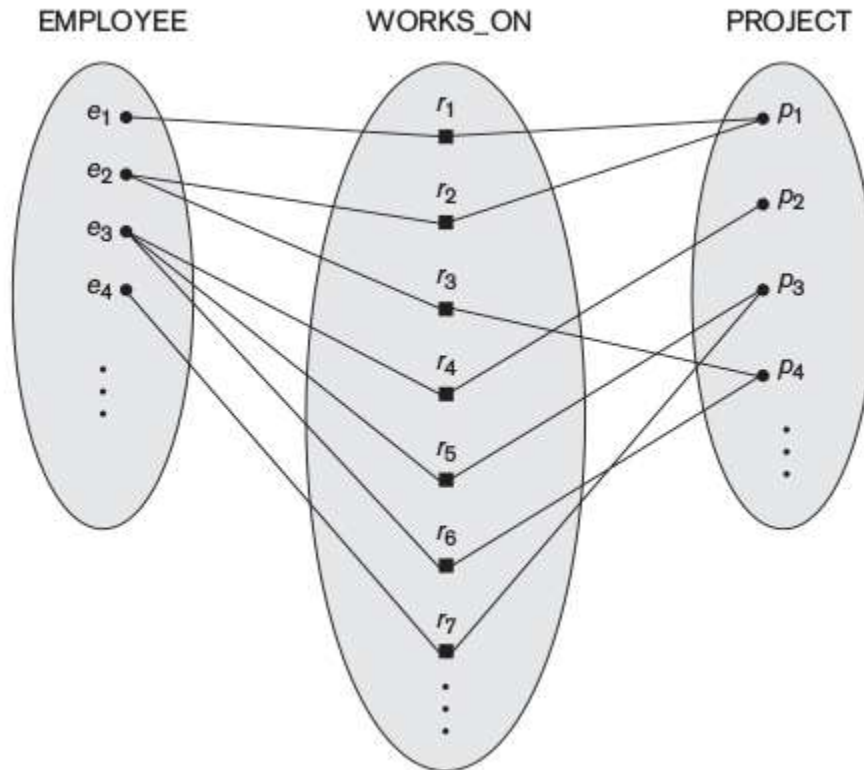
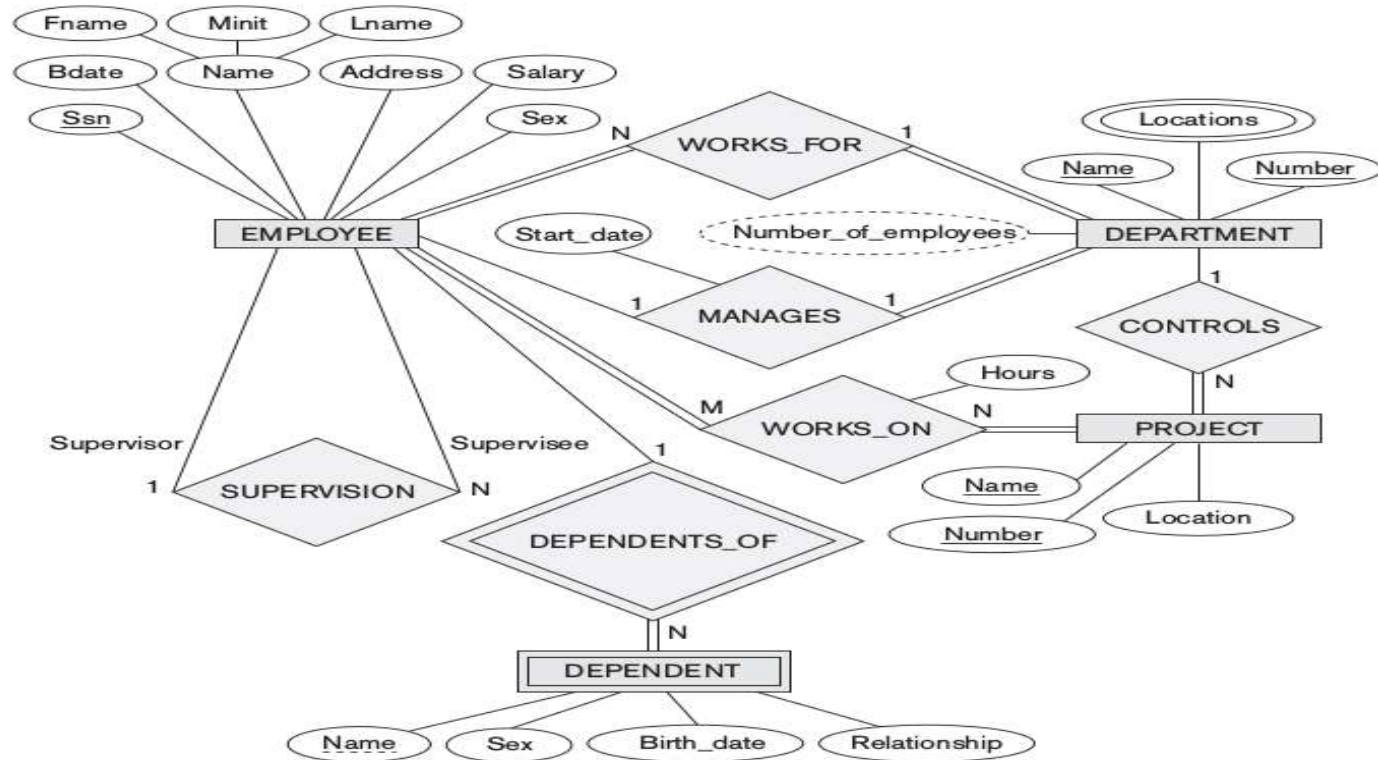
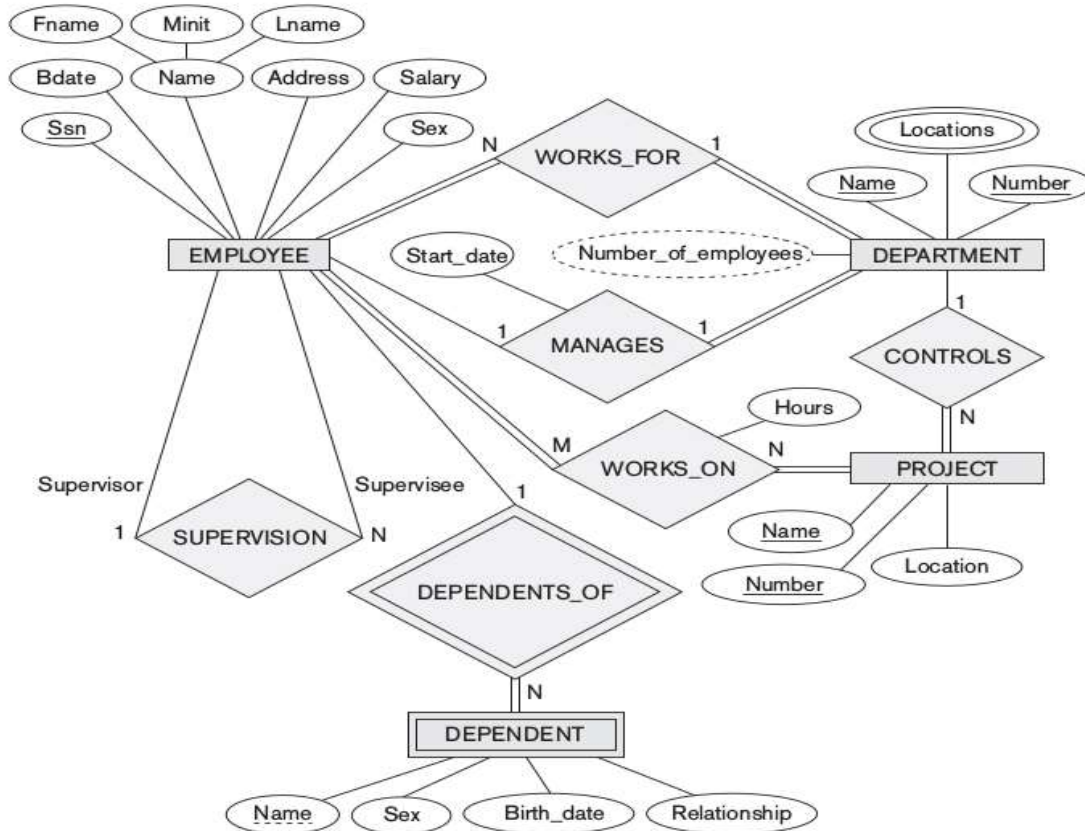


Figure 7.13
An M:N relationship,
WORKS_ON.

Binary, Ternary Relationship: ER Diagram



Total vs. Partial Participation



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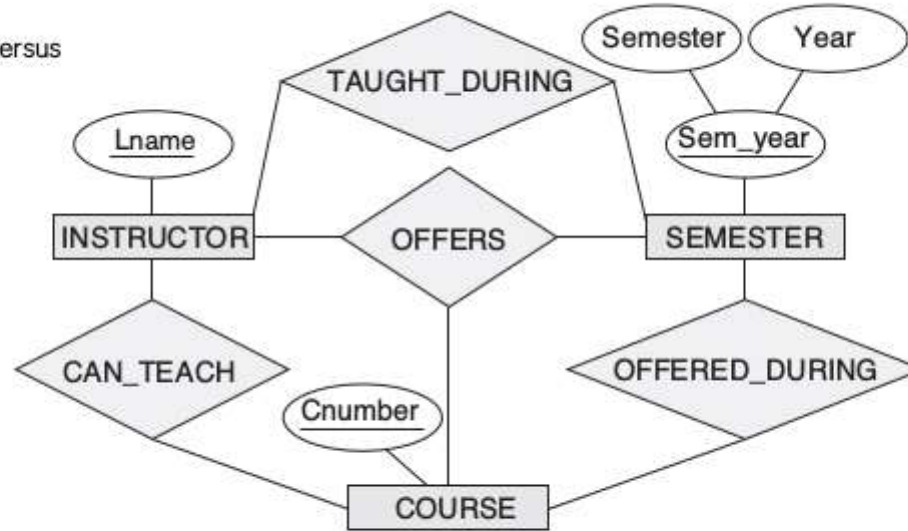
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February 28, 2019

Multiple relationships between same pair

Figure 7.18

Another example of ternary versus binary relationship types.



Q: How instances of a relationship in set get identified in ER diagram?

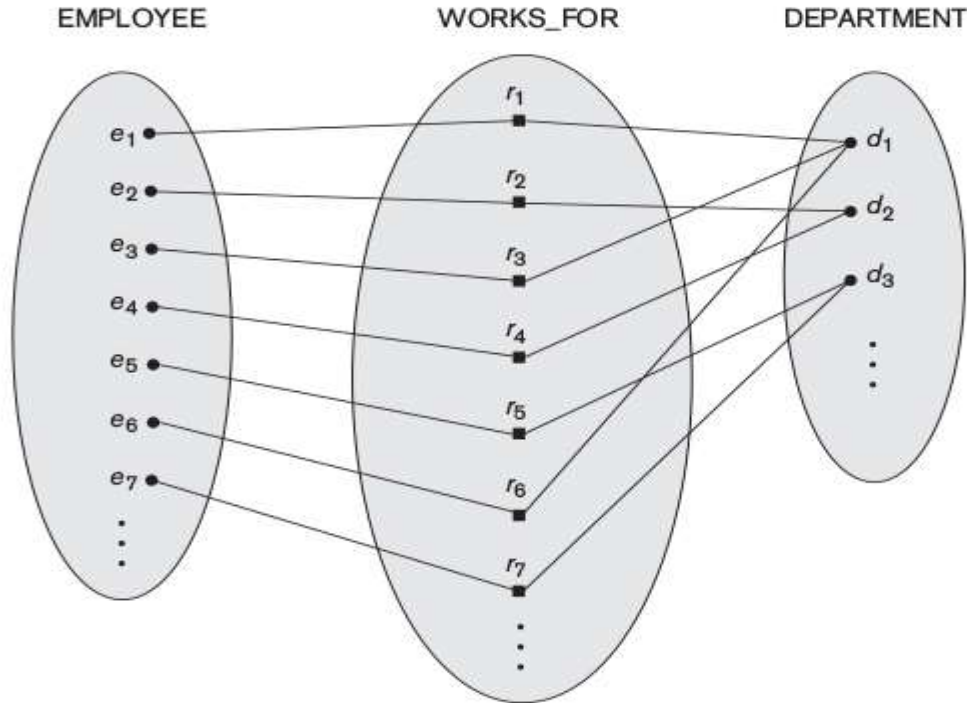


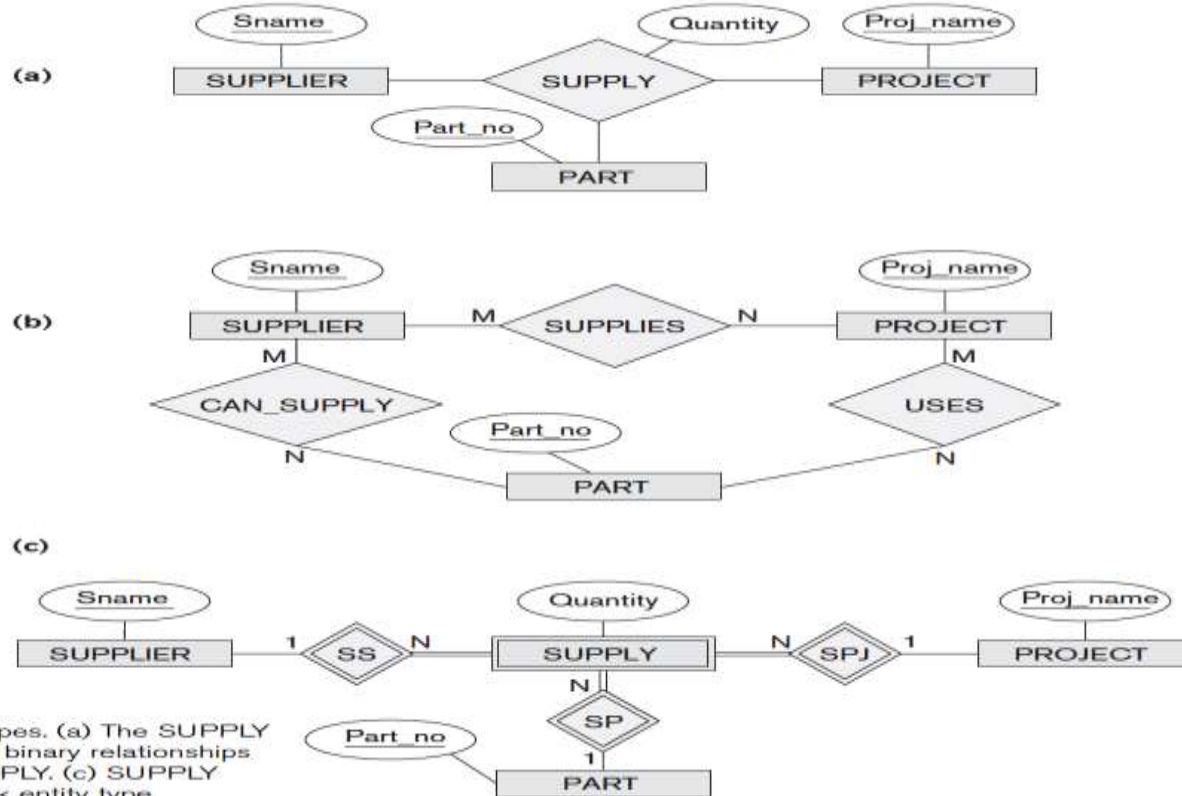
Figure 7.9

Some instances in the WORKS_FOR relationship set, which represents a relationship type WORKS_FOR between EMPLOYEE and DEPARTMENT.

Question?

Entity and relation both have attributes and instances. Can one be converted into the other?

Transformation Between Entities and Relationships: Are they Equivalent?



SUPPLIER (E), PROJECT (E), PART (E) and SUPPLY (R) sets: this is given

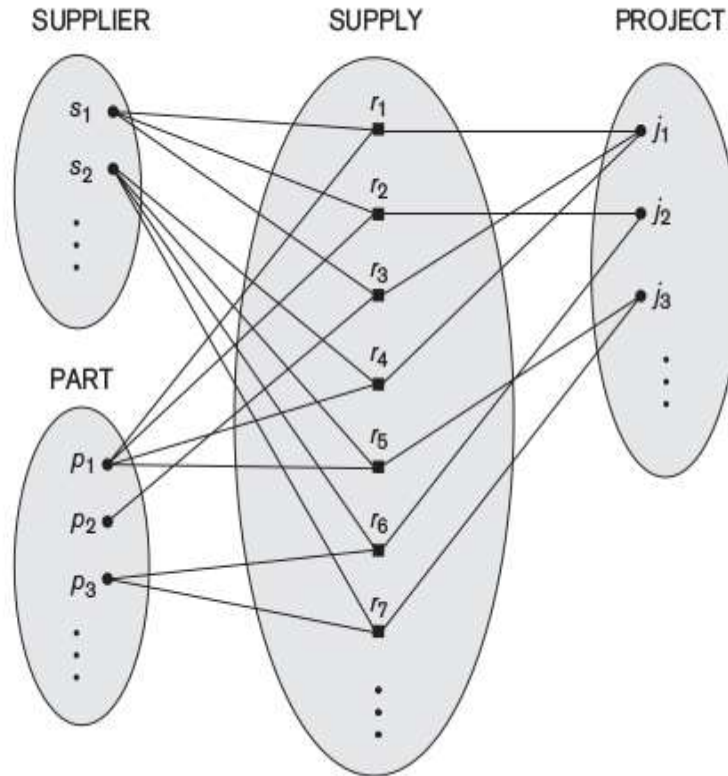


Figure 7.10

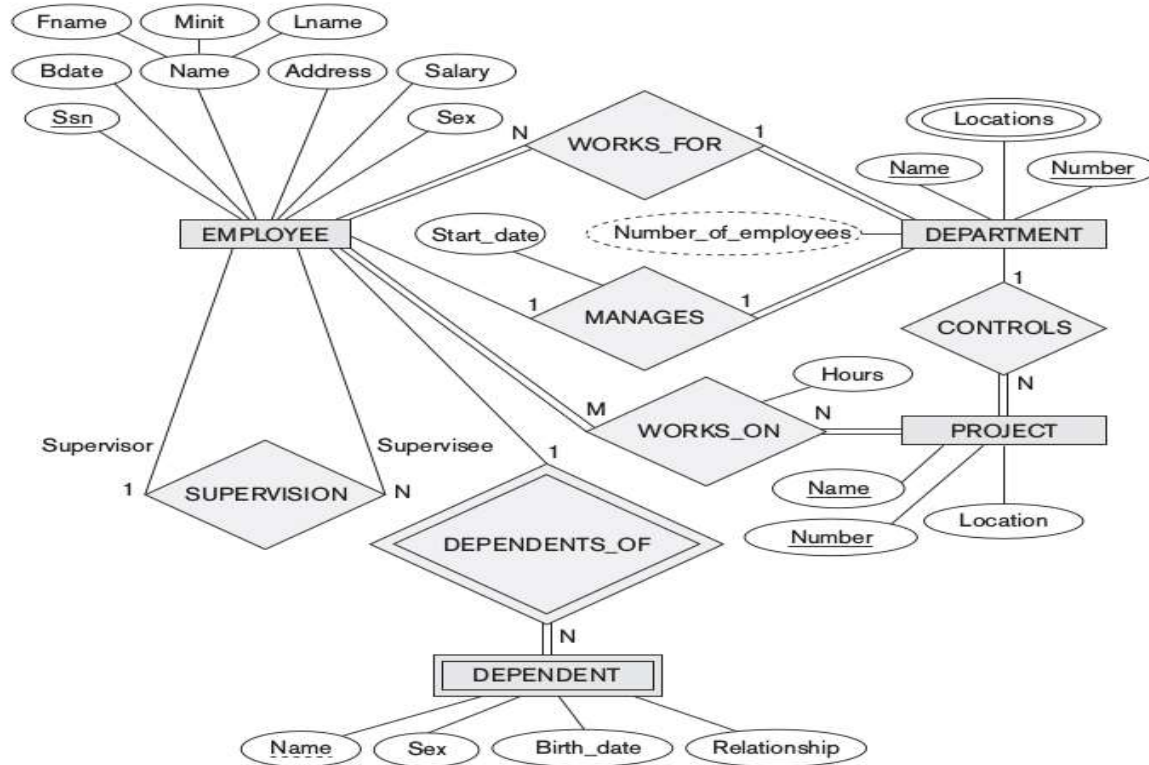
Some relationship instances in the SUPPLY ternary relationship set.

Questions

1. Draw set diagrams: SUPPLIES(R), CAN_SUPPLY (R) and USES (R).

1. Draw set diagrams: SS(R), SUPPLY (E), SPJ (R) and SP.

Weak Entity, Partial Key and Identifying/Owner Entity/Relationship: Dependent, Name and Dependents_Of



Weak Entity, Partial Key and (Ternary) Identifying Relationship

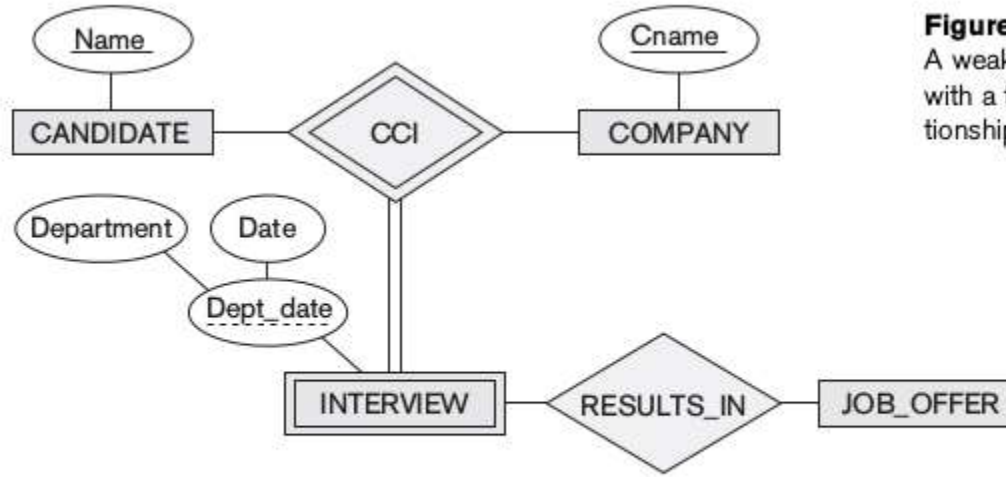
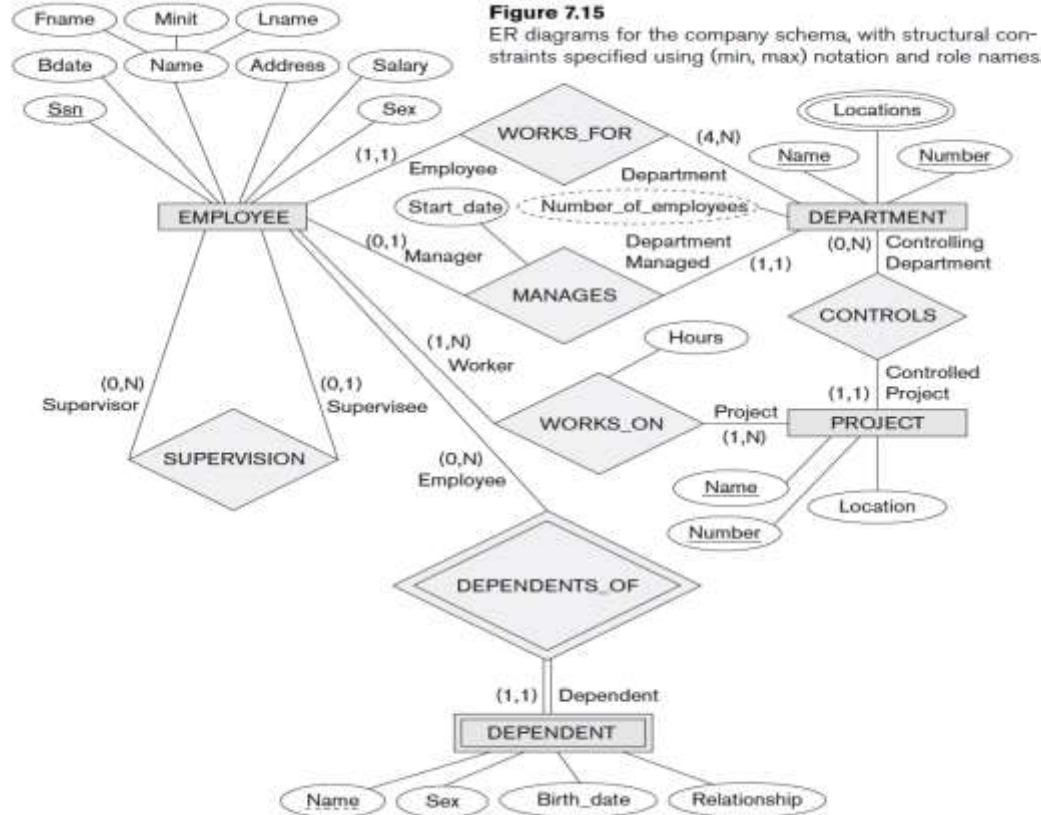


Figure 7.19

A weak entity type INTERVIEW with a ternary identifying relationship type.

Min/Max Notation to replace Cardinality ratio



UML is not in the syllabus (Ch. 7.9)

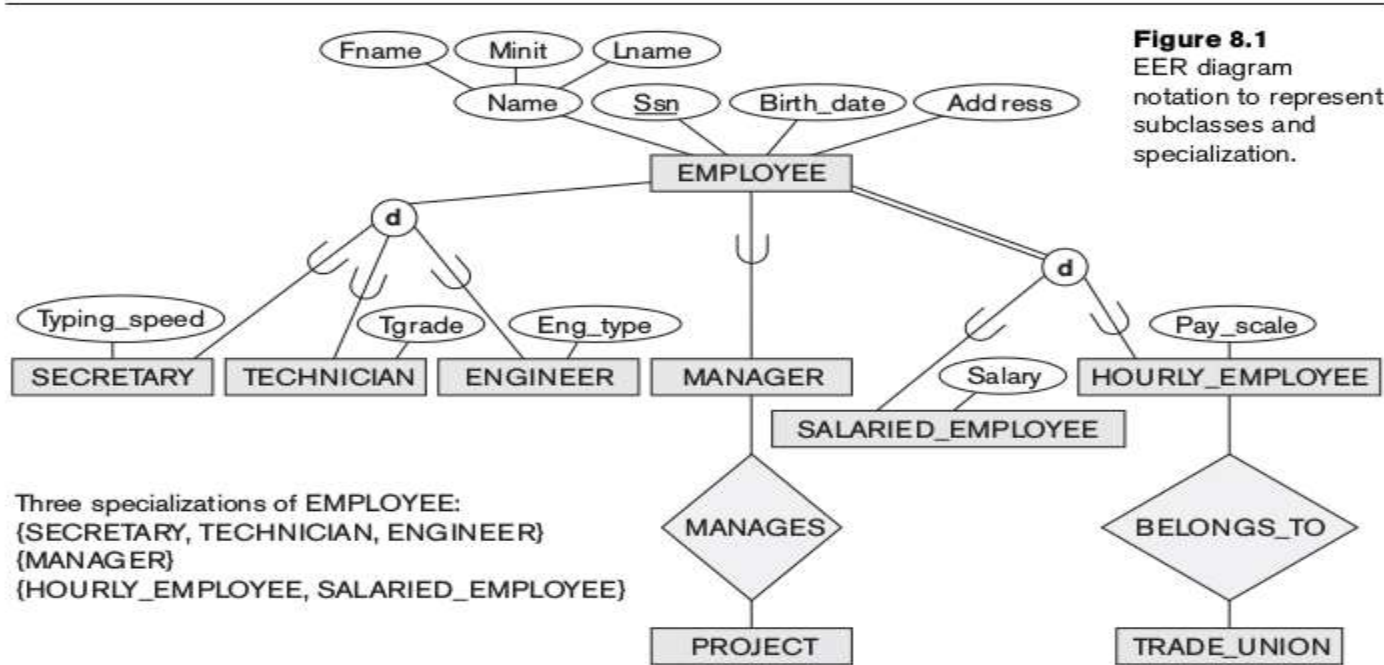
Very rough guidelines: how to draw ER diagram?

Challenge: Confusion among attribute, entity and relation

1. Start with entity and associated attributes: form islands
2. Change common attributes to relation to connect entities
3. Change attribute to an entity, if more occurrences
- 4. Iterate above steps to refine the process**

Extended Entity Relationship (EER)

Extended Entity Relationship Diagram: Specialization



Extended Entity Relationship Diagram: Set Diagram

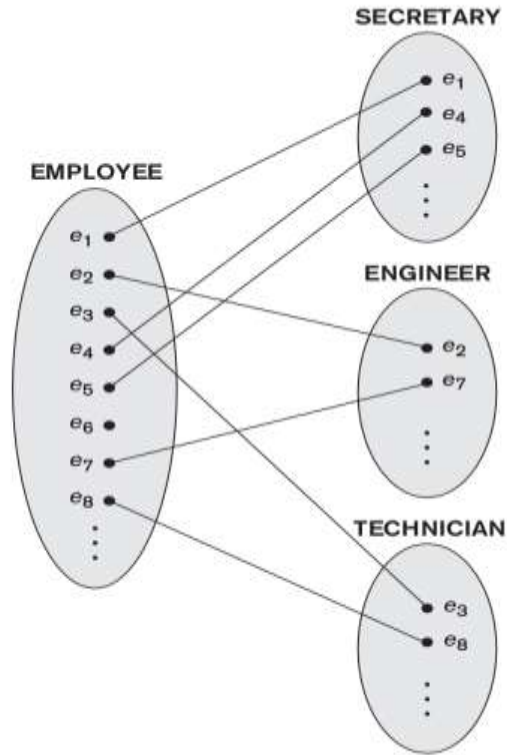


Figure 8.2

Instances of a specialization.

Extended Entity Relationship Diagram: Generalization

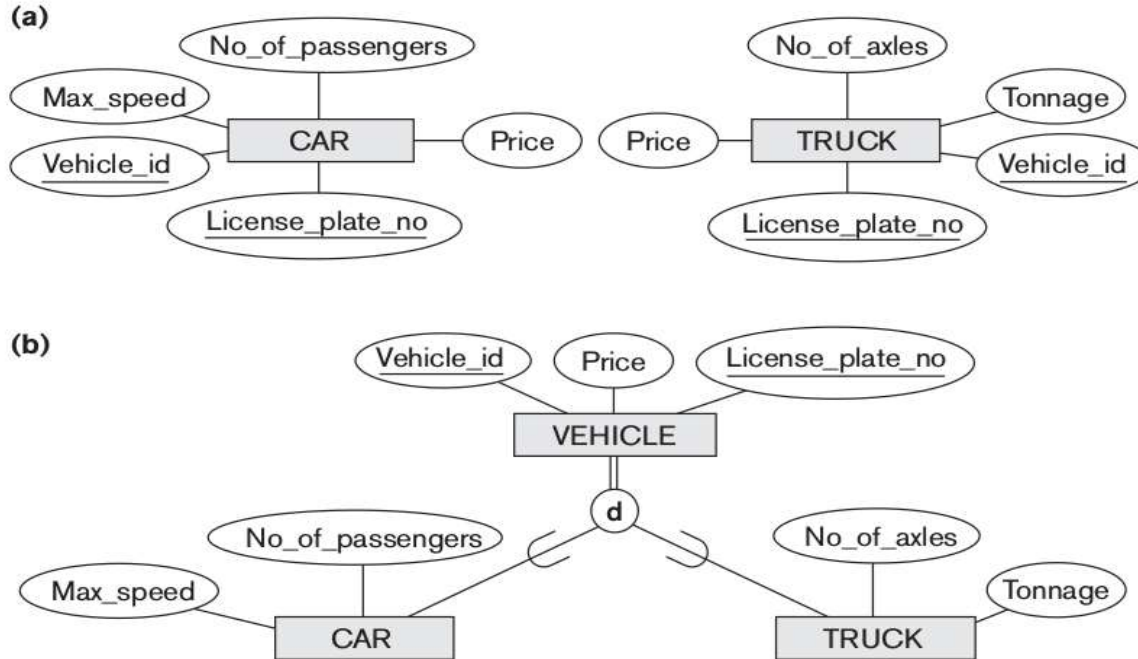


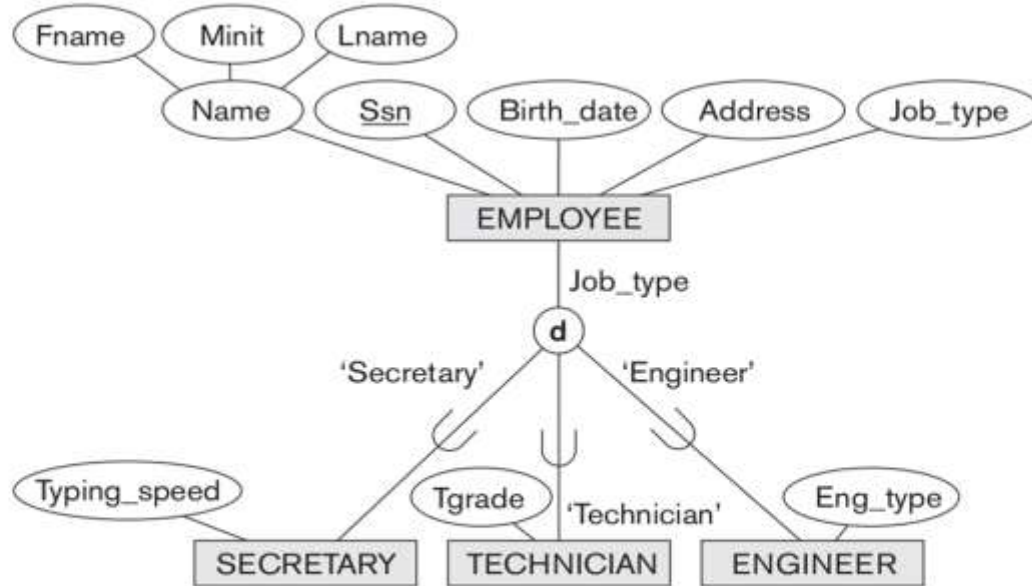
Figure 8.3

Generalization. (a) Two entity types, CAR and TRUCK. (b) Generalizing CAR and TRUCK into the superclass VEHICLE.

Extended Entity Relationship Diagram: Attributed-based Specialization

Figure 8.4

EER diagram notation for an attribute-defined specialization on Job_type.

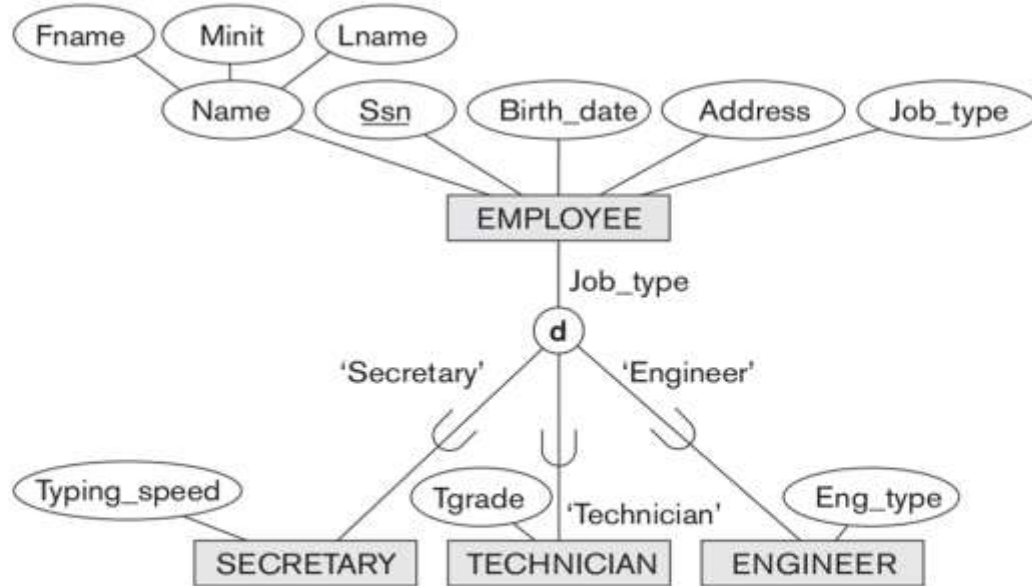


⁶Such an attribute is called a *discriminator* in UML terminology.

Extended Entity Relationship Diagram: Attributed-based Specialization

Figure 8.4

EER diagram notation for an attribute-defined specialization on Job_type.



⁶Such an attribute is called a *discriminator* in UML terminology.

Extended Entity Relationship Diagram: Overlapping and Total

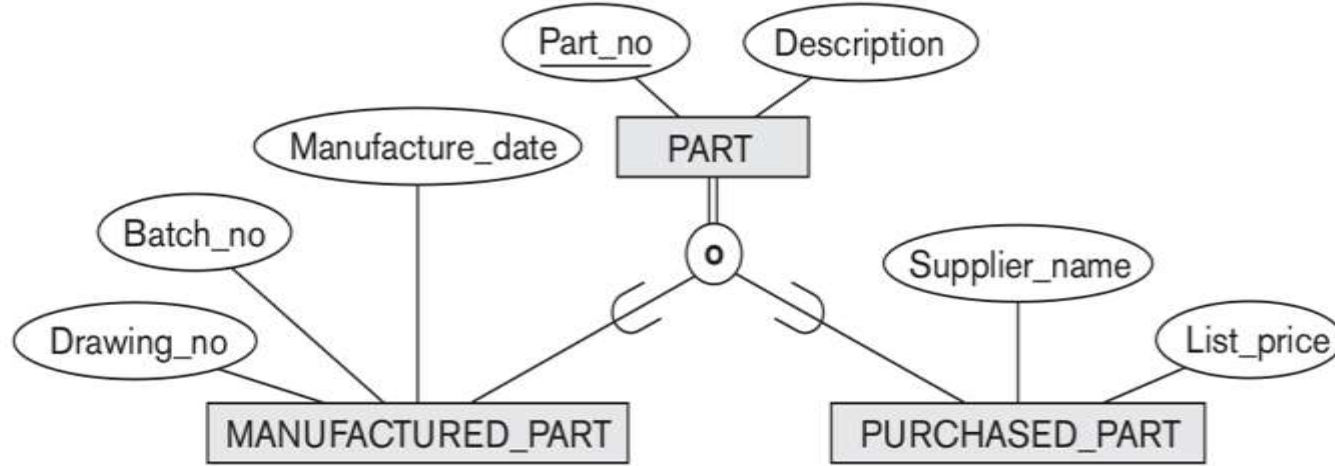
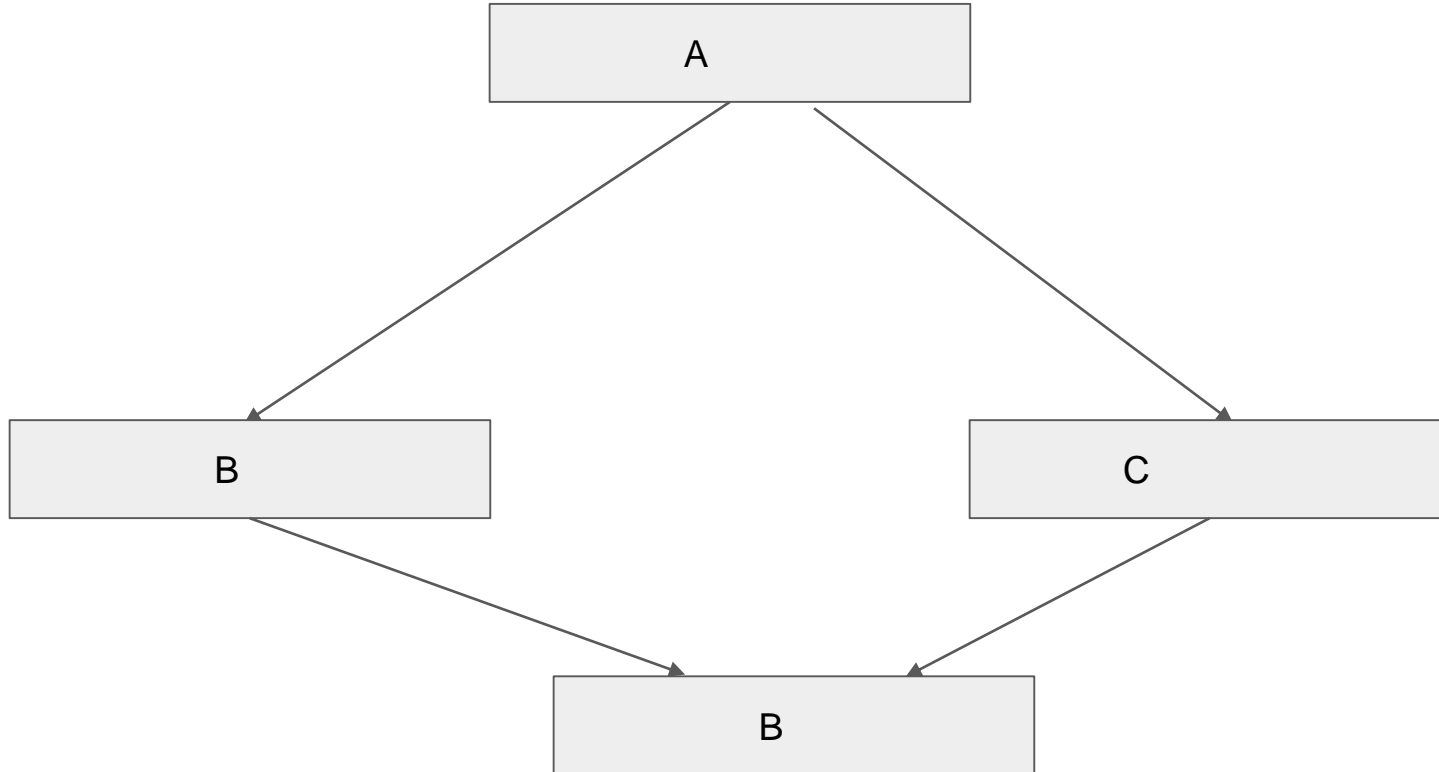


Figure 8.5
EER diagram notation
for an overlapping
(nondisjoint)
specialization.

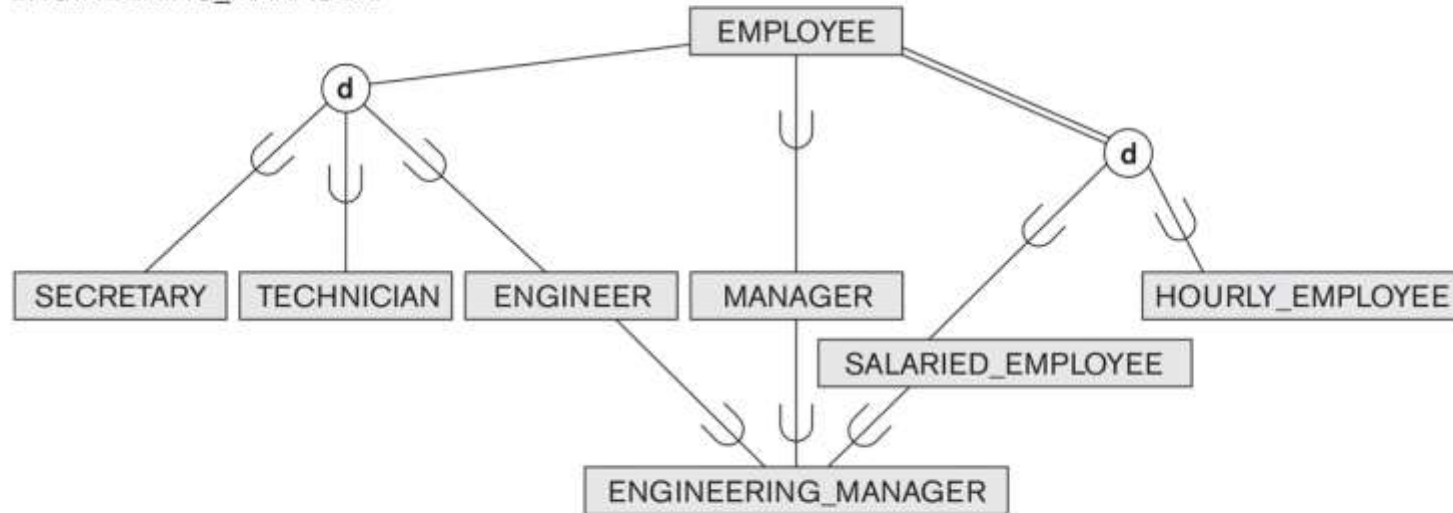
Shared Subclass: Question



Extended Entity Relationship Diagram: Shared subclass (Lattices)

Figure 8.6

A specialization lattice with shared subclass
ENGINEERING_MANAGER.



Extended Entity Relationship Diagram: Multiple Inheritance

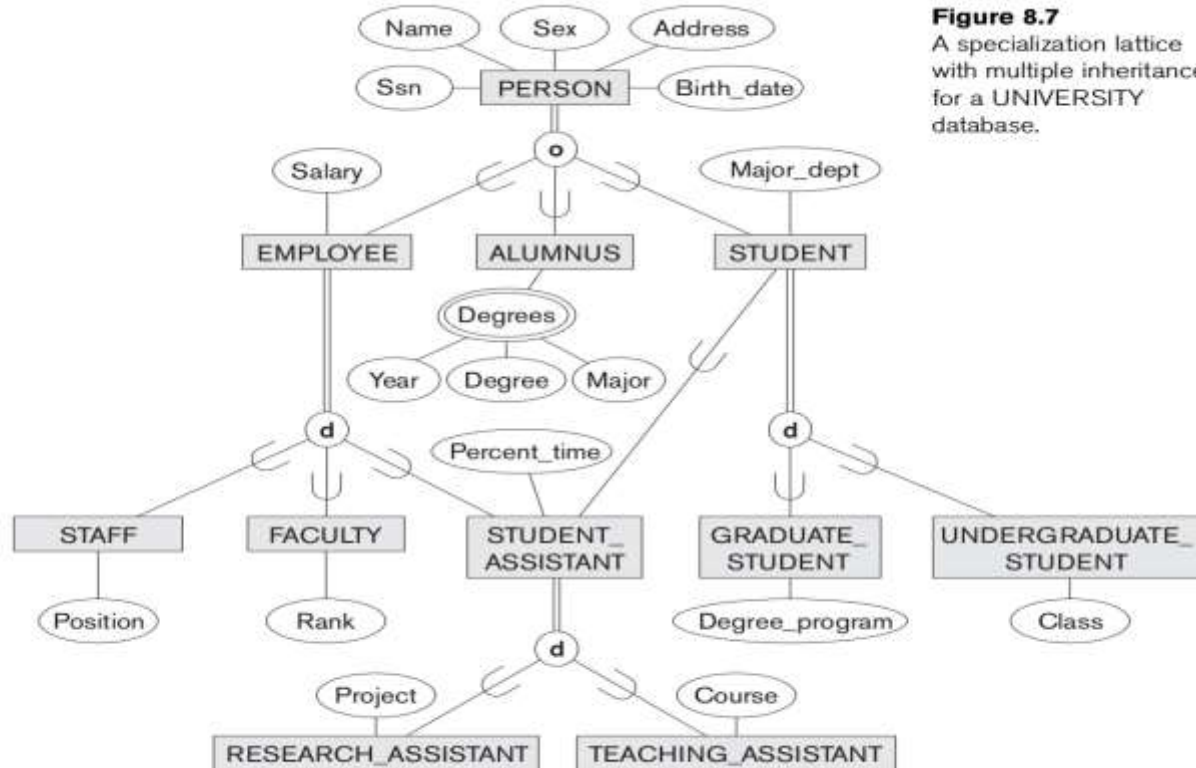


Figure 8.7

A specialization lattice with multiple inheritance for a UNIVERSITY database.