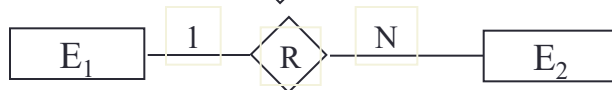
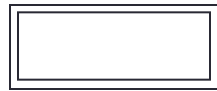


Review of Last Lecture

Symbol



Meaning

ENTITY TYPE

WEAK ENTITY TYPE

RELATIONSHIP TYPE

IDENTIFYING RELATIONSHIP TYPE

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

SOME USE ARROW TO REPRESENT TOTAL PARTICIPATION



Today's Plan

- How to map elements in ERD to a relational data model
 1. Mapping of Regular Entity Types
 2. Mapping of Multivalued attributes
 3. Mapping of Weak Entity Types
 4. Mapping 1:1
 5. Mapping 1 to N
 6. Mapping N to M
 7. Mapping ternary and n-ary



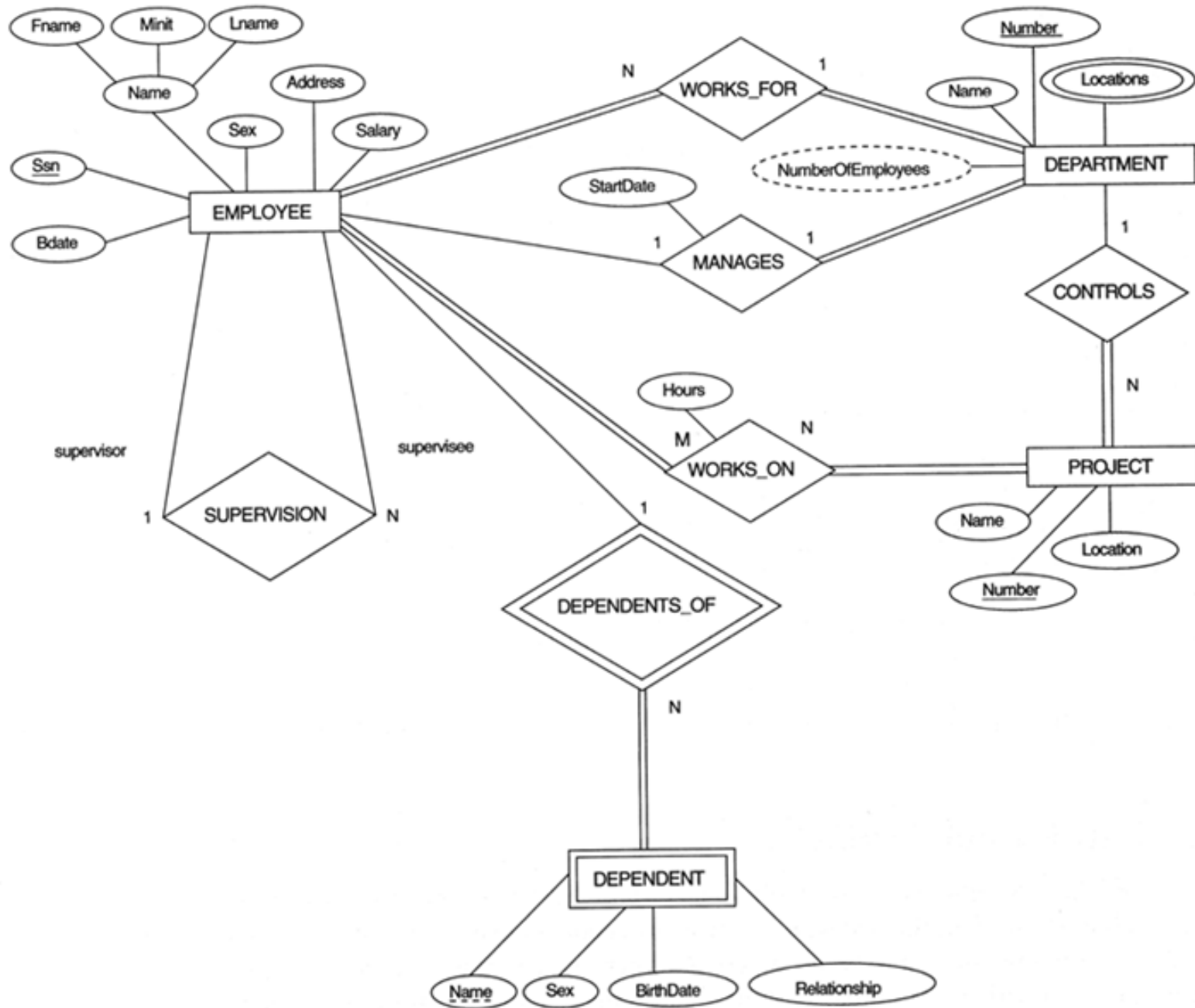
MAPPING ERD TO RELATIONAL MODEL

CHAPTER 07

Collin Roberts
University of Waterloo



The ER schema diagram for the COMPANY database. ⁴



Logical Design

- ER used in **conceptual design**
- Primary keys allow entity sets and relationship sets to be expressed uniformly as *tables* which represent the contents of the database.
- ER $\rightarrow$ Relational Schema: **logical design**
- For each entity set and relationship set there is a unique table which is assigned the name of the corresponding entity set or relationship set.
- Each table has a number of columns (generally corresponding to attributes), which have unique names.



Basic Principles of Mapping ER/EER to Relational Model

- Criteria:
 - No loss of information
 - Minimal redundancy
 - Minimize the use of NULL
- Basic rules:
 - One table for each entity (optionally + FK)
 - Same names, same attributes and same PK
 - Relationship:
 - FK
 - Table + FK



Mapping Outline

- ER-to-Relational Mapping Algorithm

Step 1: Mapping of Regular Entity Types

Step 2: Mapping of Multivalued attributes

Step 3: Mapping of Weak Entity Types

Step 4: Mapping of Binary 1:1 Relation Types

Step 5: Mapping of Binary 1:N Relationship Types.

Step 6: Mapping of Binary M:N Relationship Types.

Step 7: Mapping of N-ary Relationship Types.

- Mapping EER Model Constructs to Relations (Not Covered)

Step 8: Options for Mapping Specialization or Generalization.

Step 9: Mapping of Union Types (Categories).

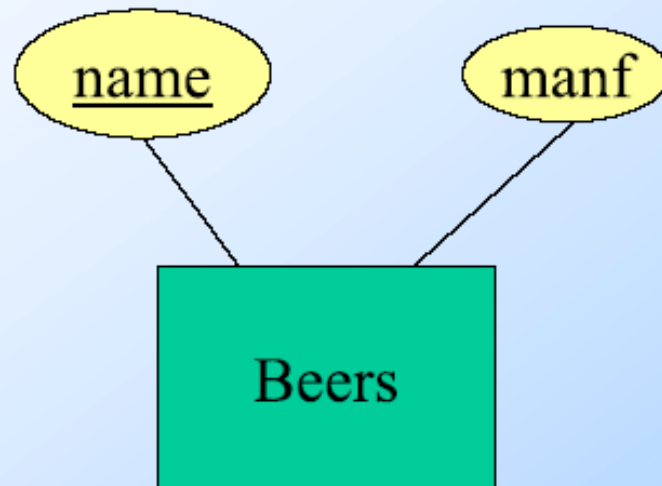


Step 1: Strong Entity

- **Step 1: Mapping of Regular Entity Types.**
 - For each regular (strong) entity type E, create a relation R that includes all the simple attributes of E.
 - Same names
 - Primary key (PK) of E becomes PK of R.



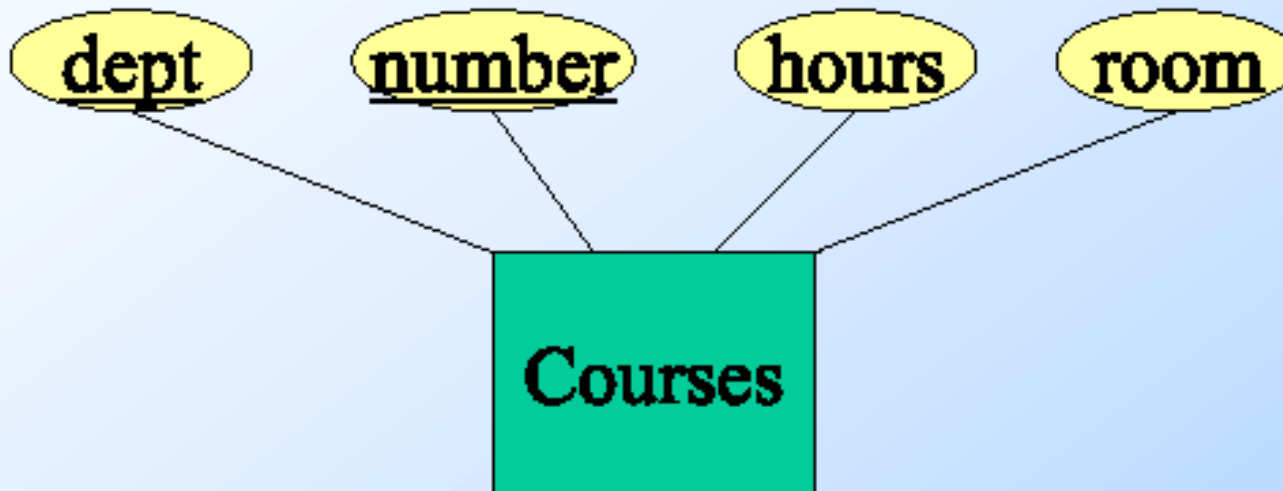
Example: Strong Entity Set



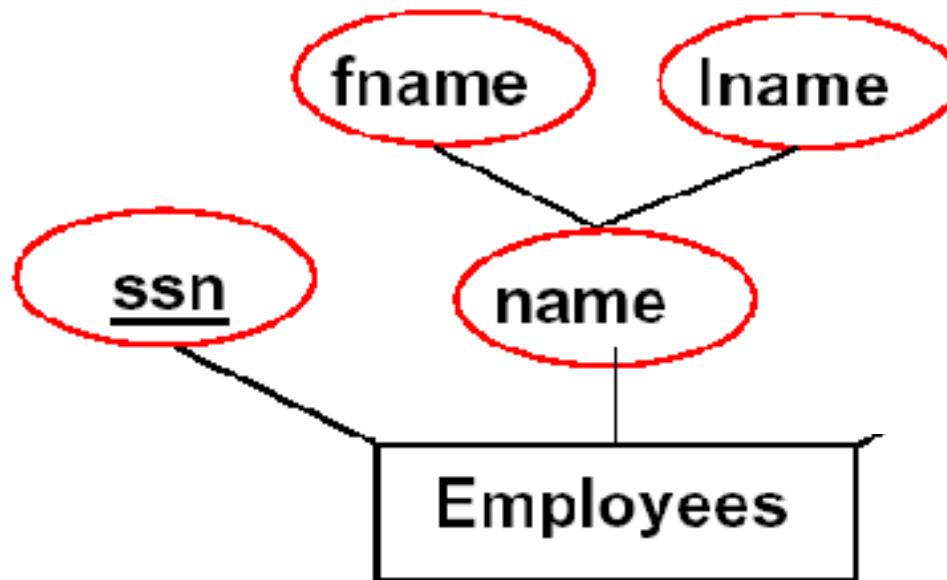
Relation: Beers(name, manf)



Example: Multi-attribute key



Example: Composite Attribute

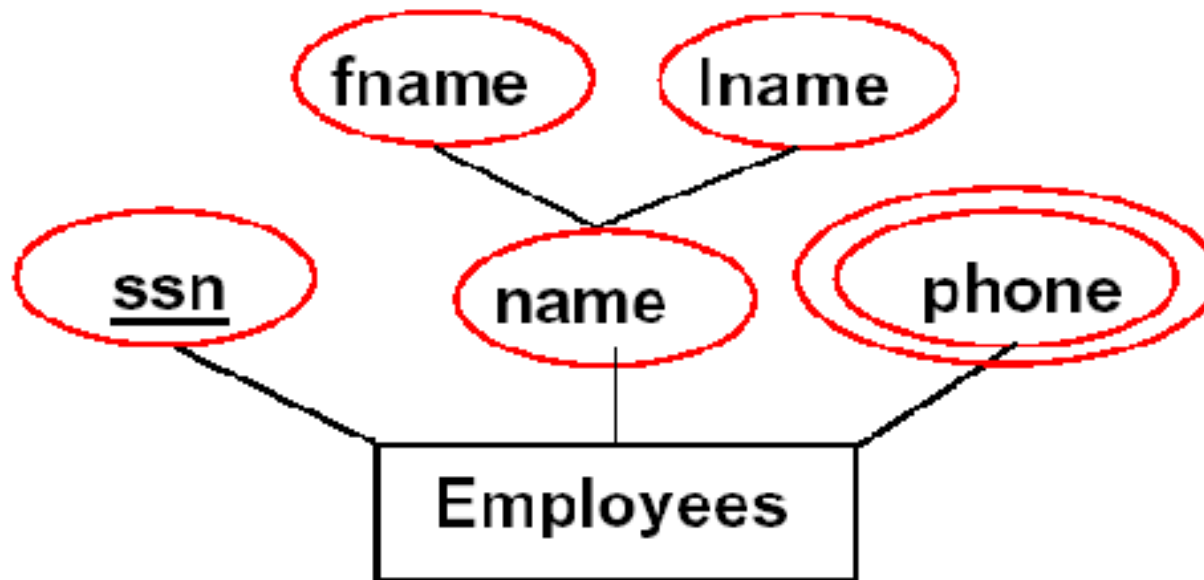


Step 2: Multivalue

- **Step 2: Mapping of Multivalued attributes.**
 - Suppose A is a multi-valued attribute, belonging to a relation (or attribute) named S.
 - Create a new relation, R.
 - R will include an attribute corresponding to A, plus PK attribute, K, of S.
 - Make K a FK to S.K in R
 - Make the PK of R = A + K



Example: Mapping Multivalued Attribute



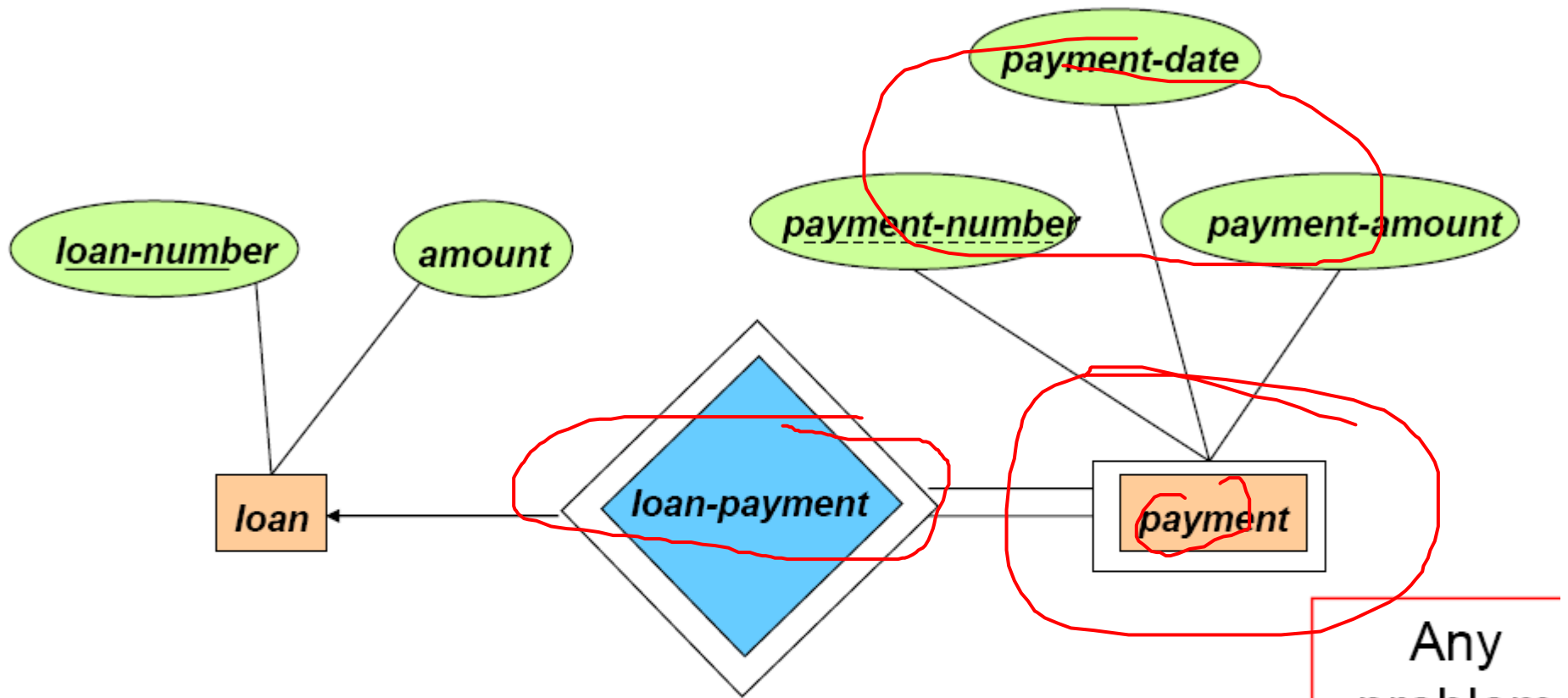
Step 3: Weak Entity

- **Step 3: Mapping of Weak Entity Types**

- For each weak entity type W with owner entity type E , create a relation R and include all simple attributes of W as attributes of R .
- Include the primary key of owner as foreign key of R
- PK of $R = PK$ of the owner + the partial key of W
- The Identifying relationship is ignored!



Example: Identifying Relationship



payment = { loan-number, payment-number, payment-date, payment-amount }

loan = { loan-number, amount }

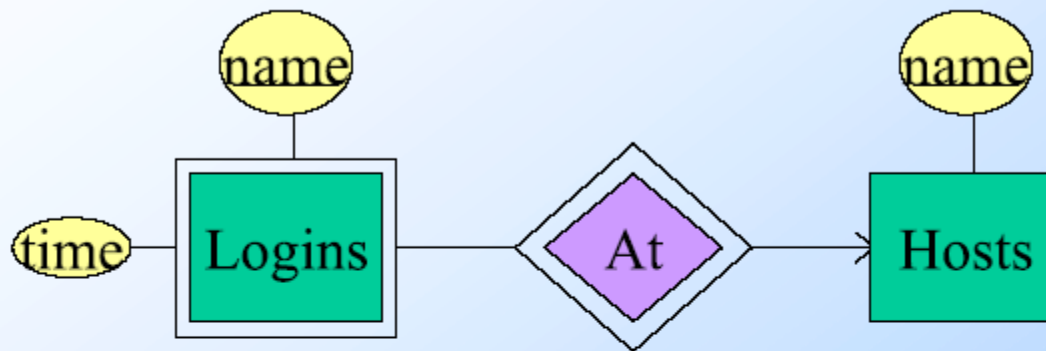
loan-payment = { loan-number, payment-number }

Any problem here?

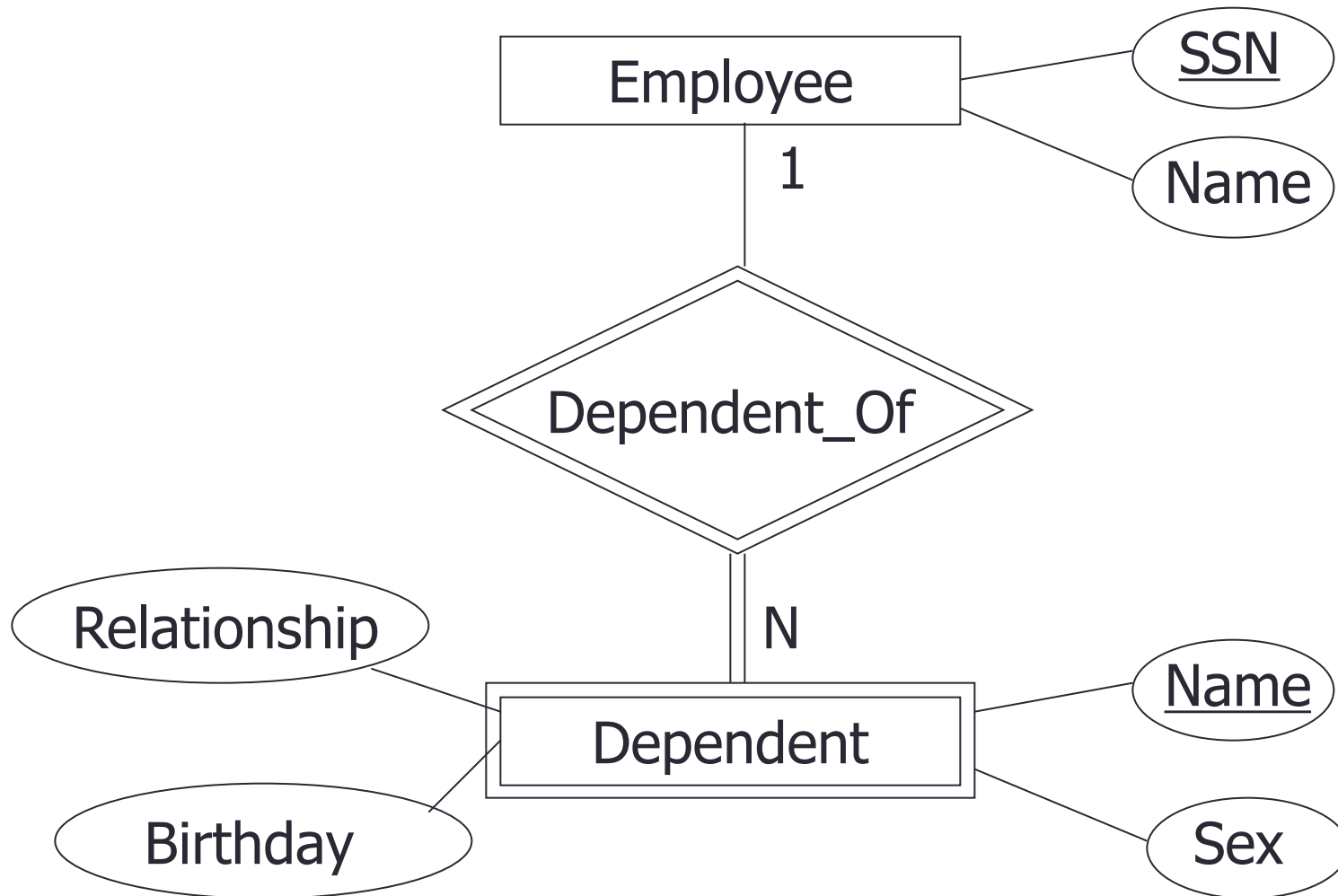
Redundancy!



Exercise: Weak Entity Set



Exercise: Weak Entity Set



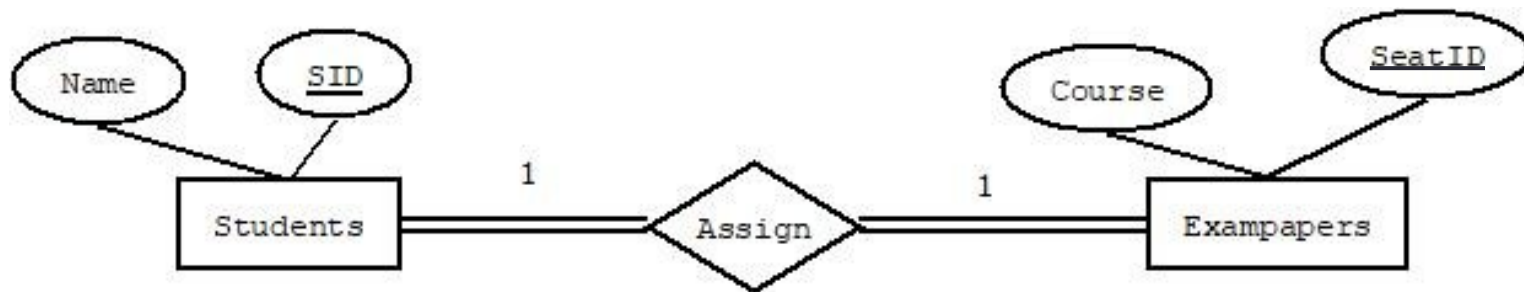
Step 4: 1 to 1

- **Step 4: Mapping of Binary 1:1 Relation Types**
- For each 1:1 relationship R, identify the participating relations S and T. Three possible approaches:
 - 1) Foreign Key approach: If only the participation of S is total, include PK of T as FK in S.
 - 2) Merged relation option: If participations of S and T are both total, merging S and T and the relationship into a single relation.
 - One of PK becomes PK of the new relation
 - 3) Cross-reference option: If none is total, set up a third relation C which includes PKs of S and T as FKs.
 - One of the PKs will form the primary key of C.



Example: Mapping 1:1 – Both Total

- Exam seating: students, exampapers (both are total)



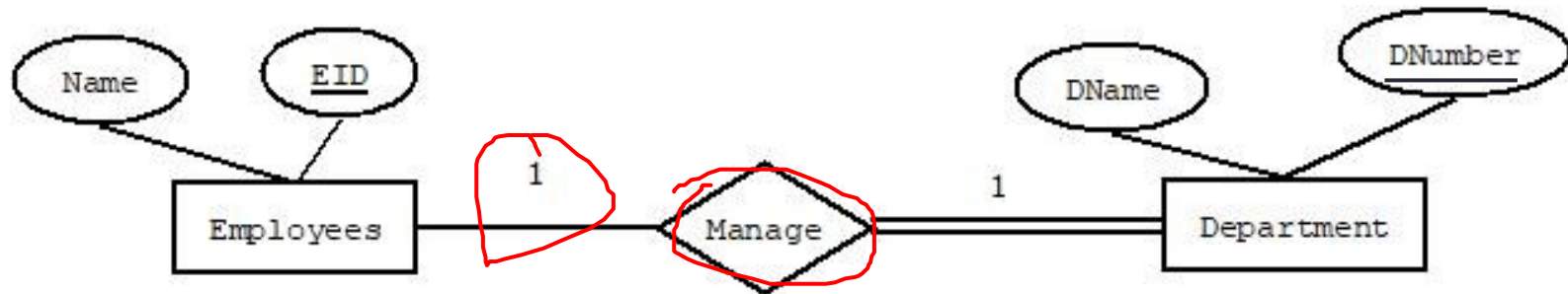
Before: Students(Name, SID)
 Exampapers(Course, SeatID)

After: SE(Name, SID, Course, SeatID)



Example: Mapping 1:1 – One Total

- Manage: employee, department (department is total)



Before:

Employees(Name, EID)

Department(DName, DNumber)

After:

Employees(Name, EID)

Department(DName, Dnumber, MgrEID)

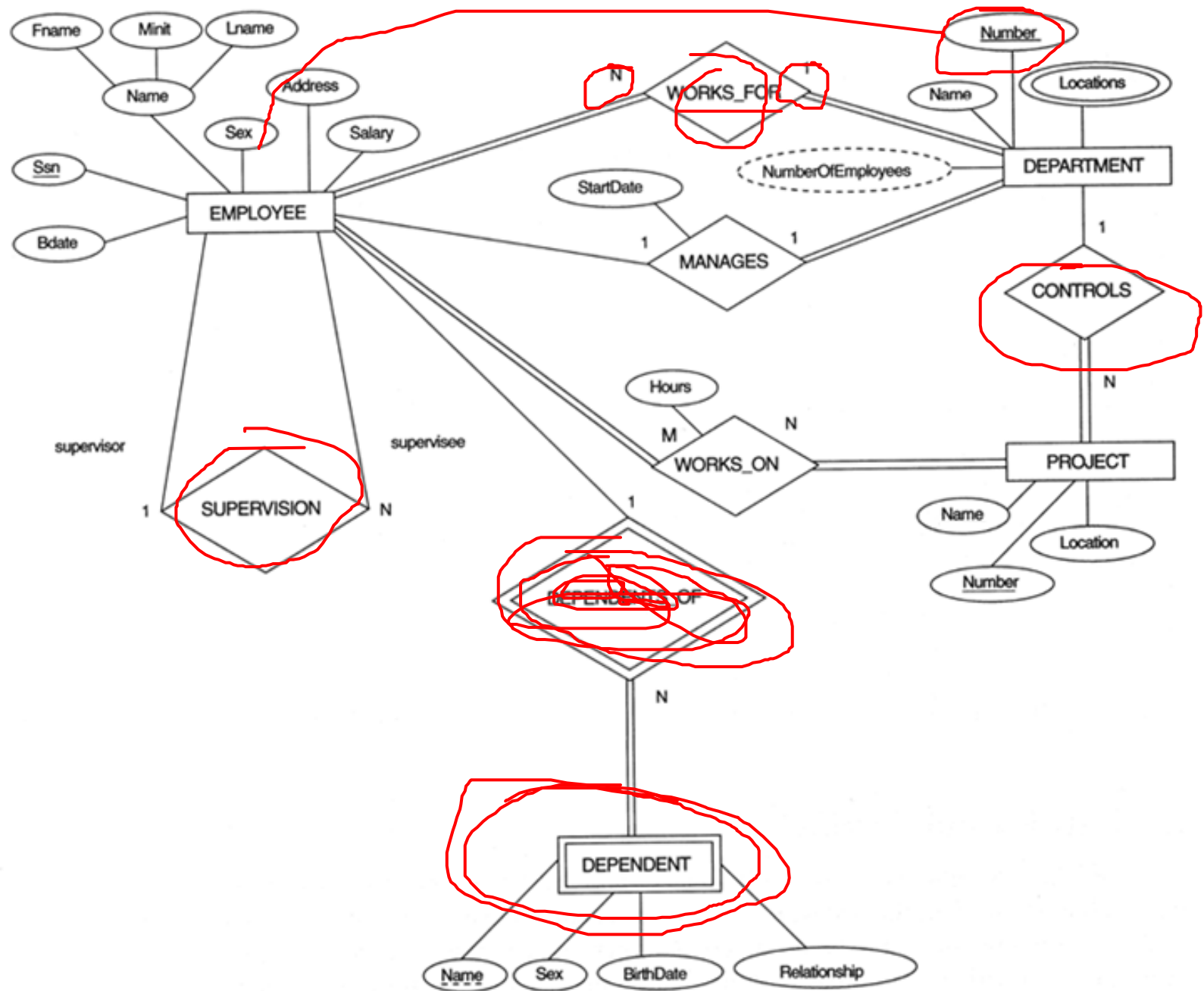


Step 5: 1 to Many

- **Step 5: Mapping of Binary 1:N Relationship Types.**
 - Assume S and T are participants and relation S is at the N-side
 - Include PK of T as FK in S
 - Include any simple attributes of the relationship as attributes of S.

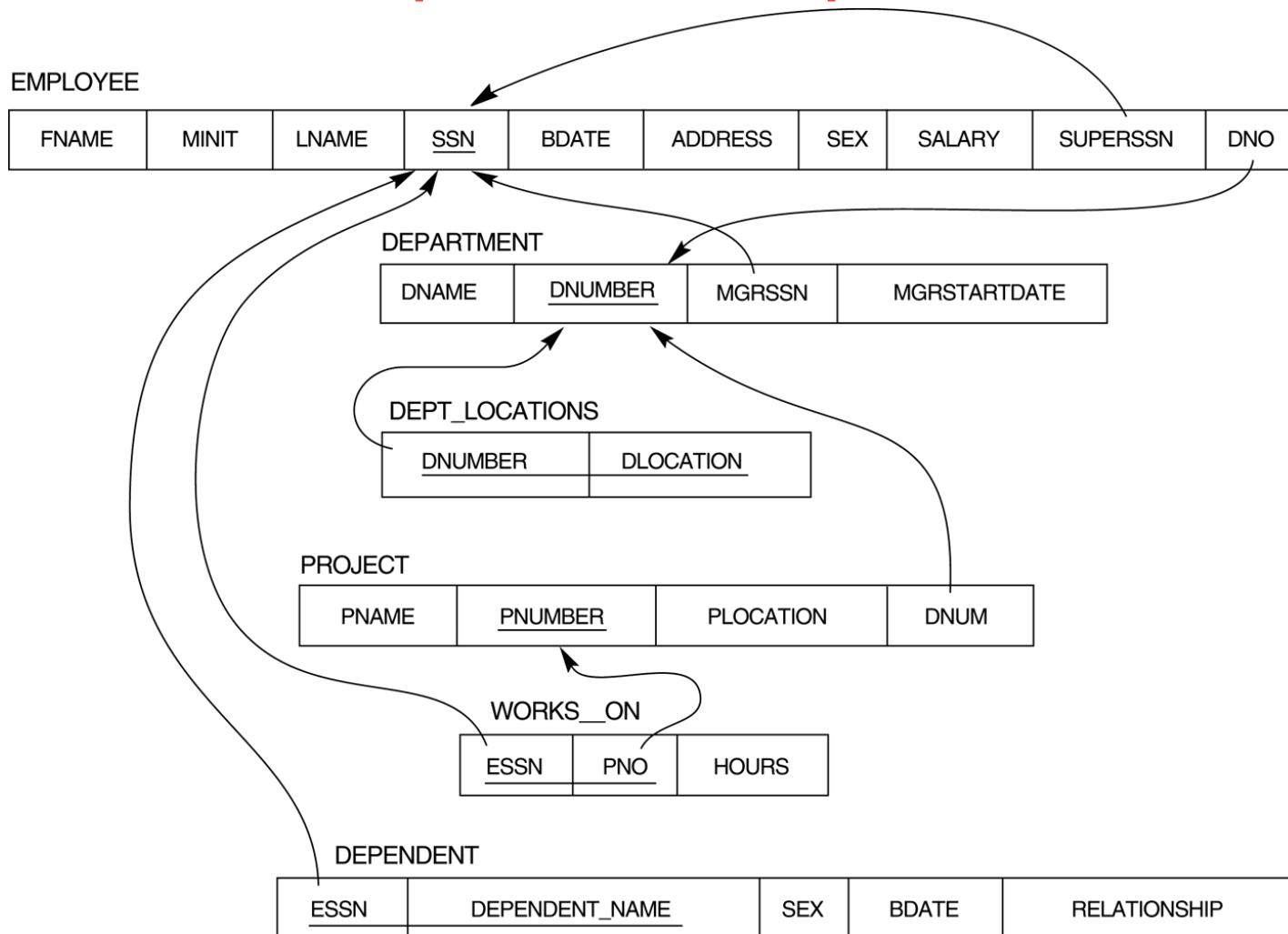


The ER schema diagram for the COMPANY database.



Mapping to Relations

--- A Complete Example

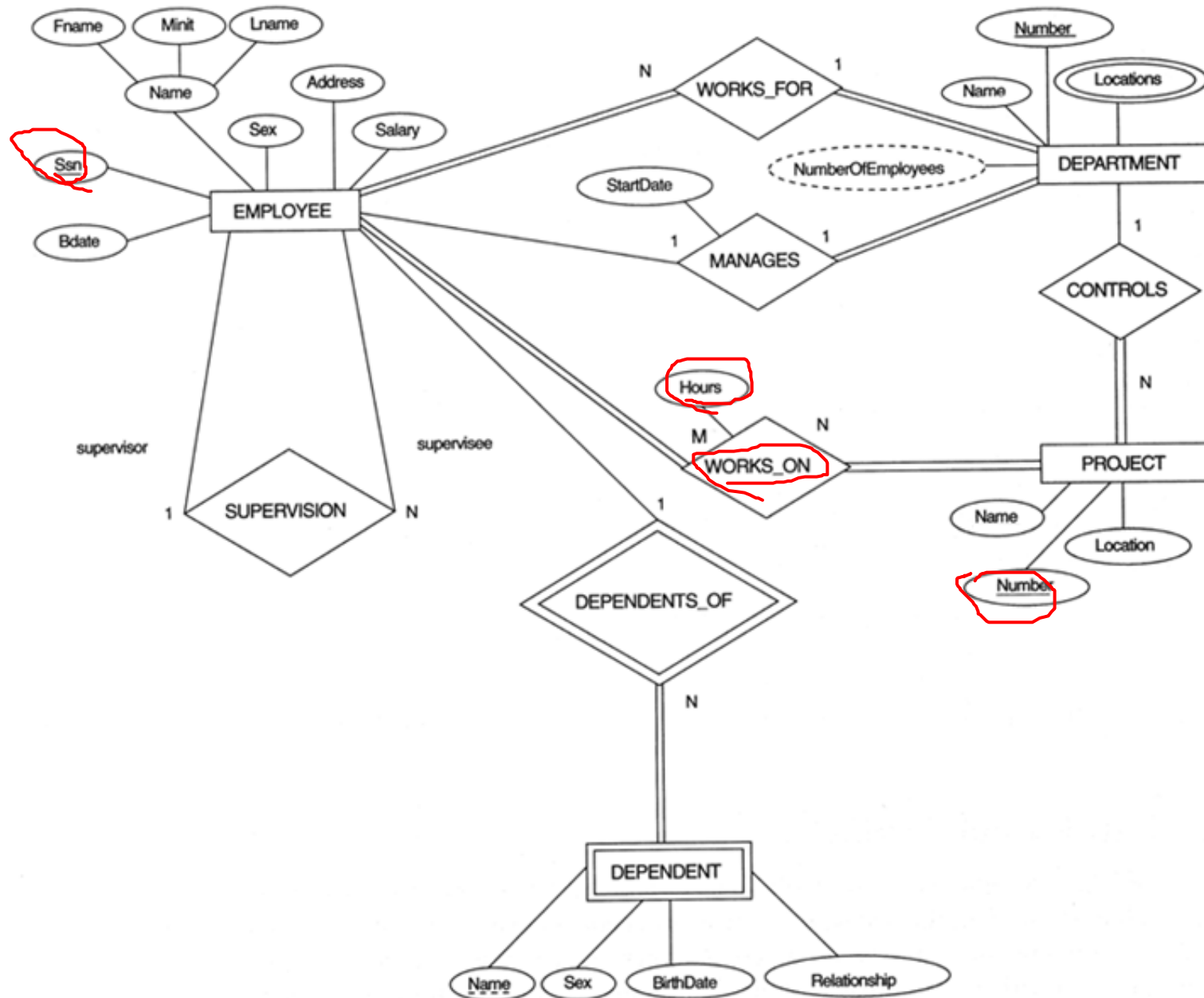


Step 6: Many to Many

- **Step 6: Mapping of Binary M:N Relationship Types.**
 - For each M:N relationship type R, create a new relation C to represent R. (S and T are participants)
 - Include PKs of S and T as FKs in C
 - Their combination will form the primary key of C.
 - Include any simple attributes of R as attributes of C.

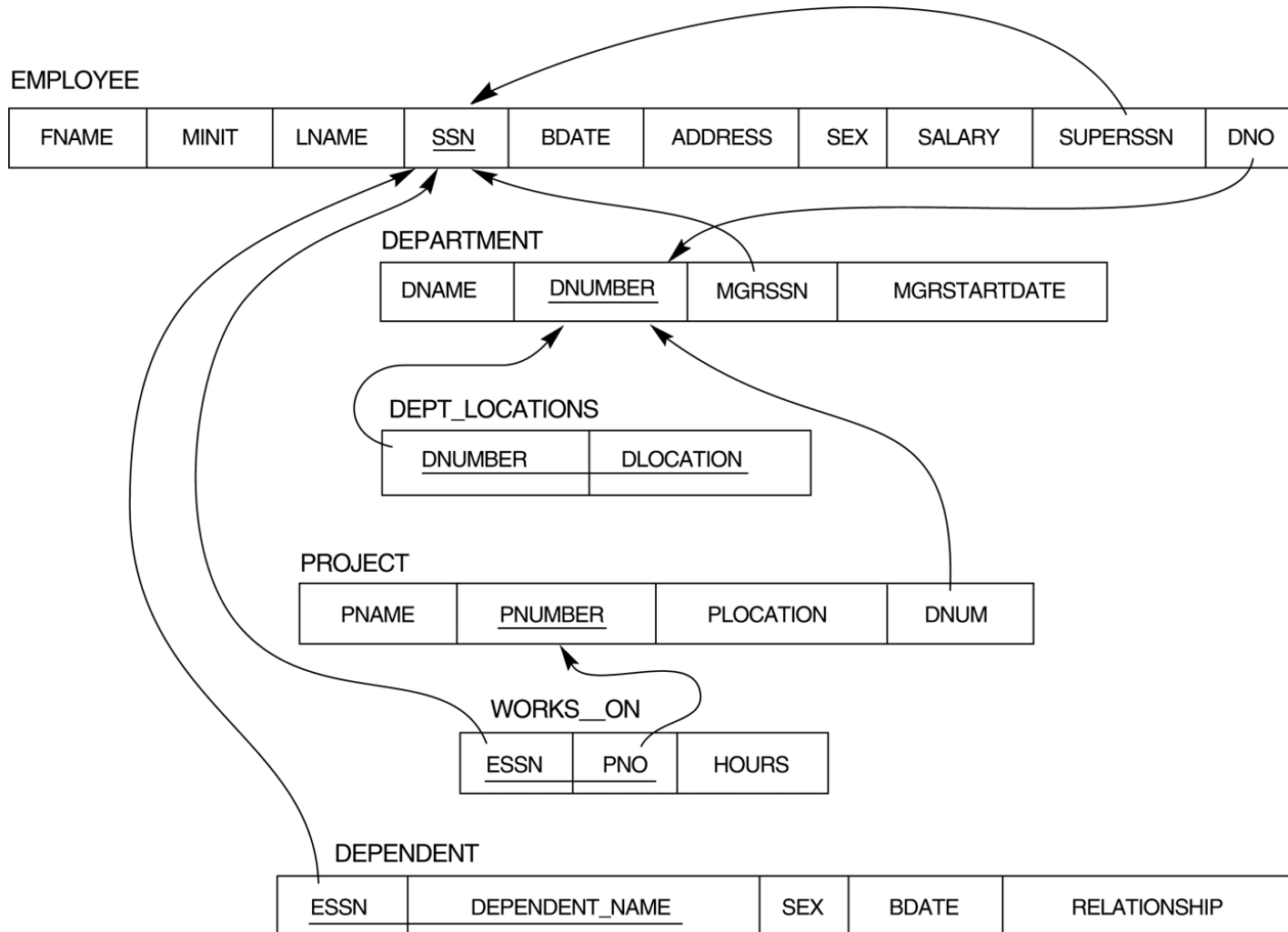


The ER schema diagram for the COMPANY database. ²⁶

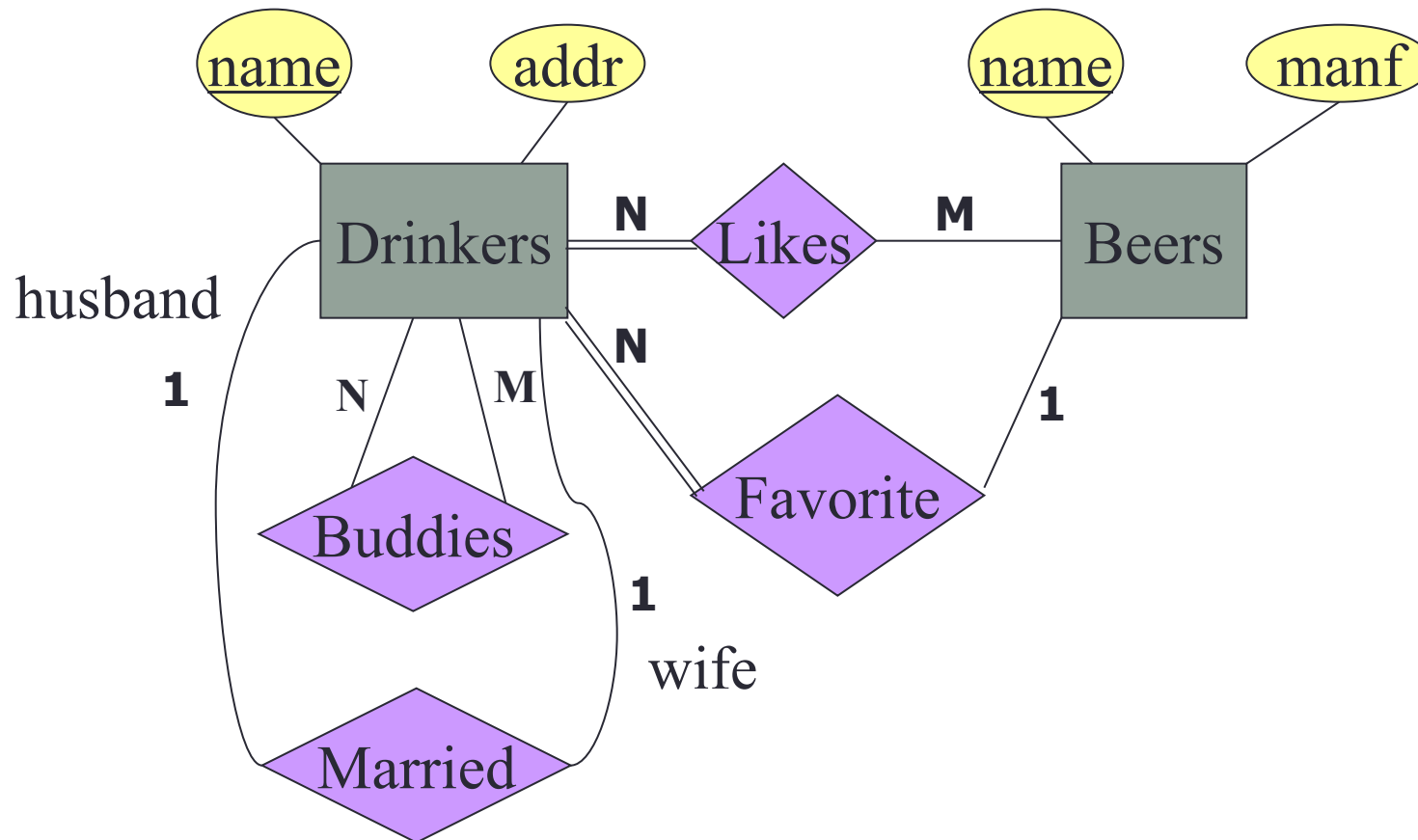


Mapping to Relations

--- A Complete Example



Exercise: Relationship to Relation

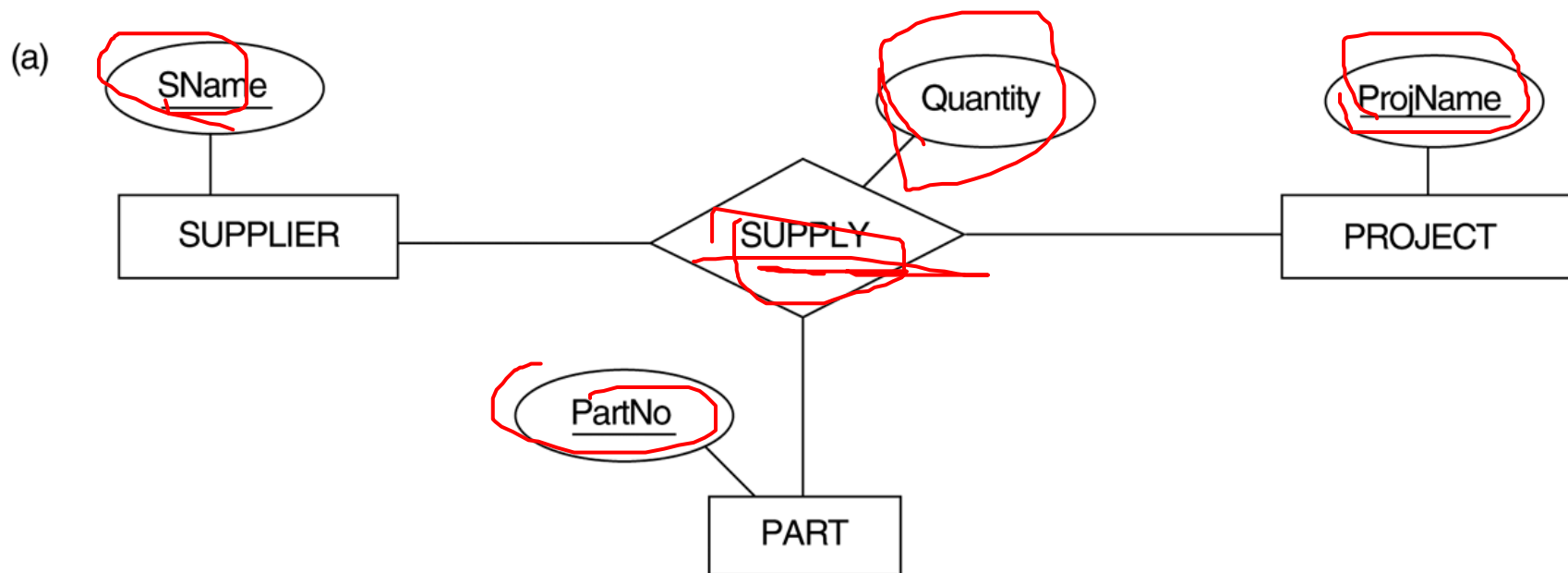


Step 7: N-ary

- **Step 7: Mapping of N-ary Relationship Types.**
 - For each n-ary relationship type R, create a new relation C to represent R
 - Include PKs of all participants as FKs in C
 - Their combination will form the primary key of S.
 - Include any simple attributes of R as attributes of C



Example: Ternary



Example: Ternary Mapping

SUPPLIER

<u>SNAME</u>	...
--------------	-----

PROJECT

<u>PROJNAME</u>	...
-----------------	-----

PART

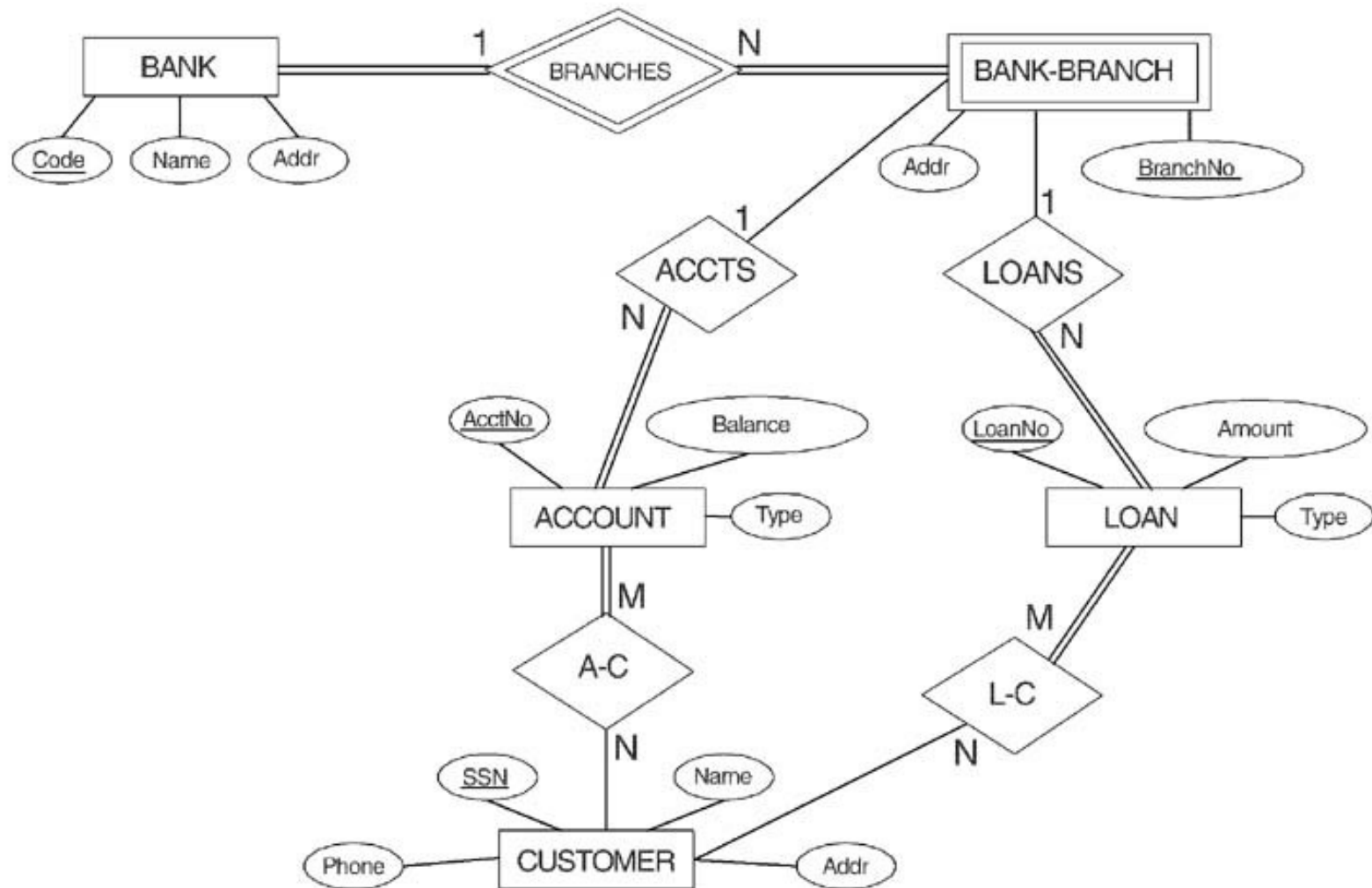
<u>PARTNO</u>	...
---------------	-----

SUPPLY

<u>SNAME</u>	PROJNAME	<u>PARTNO</u>	QUANTITY
--------------	----------	---------------	----------



In Class Exercise: Mapping



Summary of ER Mapping

ER Model

Entity type

1:1 or 1:N relationship type

M:N relationship type

n -ary relationship type

Simple attribute

Composite attribute

Multivalued attribute

Value set

Primary key

Relational Model

“Entity” relation

Foreign key (or “relationship” relation)

“Relationship” relation and two foreign keys

“Relationship” relation and n foreign keys

Attribute

Set of simple attributes

Relation and foreign key

Domain

Primary key



Summary of Today's Lecture

1. Mapping of Regular Entity Types
2. Mapping of Multivalued attributes
3. Mapping of Weak Entity Types
4. Mapping 1:1
5. Mapping 1 to N
6. Mapping N to M
7. Mapping ternary and n-ary

Note: If the relationship has simple attributes, they should be included in the new table or in the FK table.

