Translation of EER model into relational model

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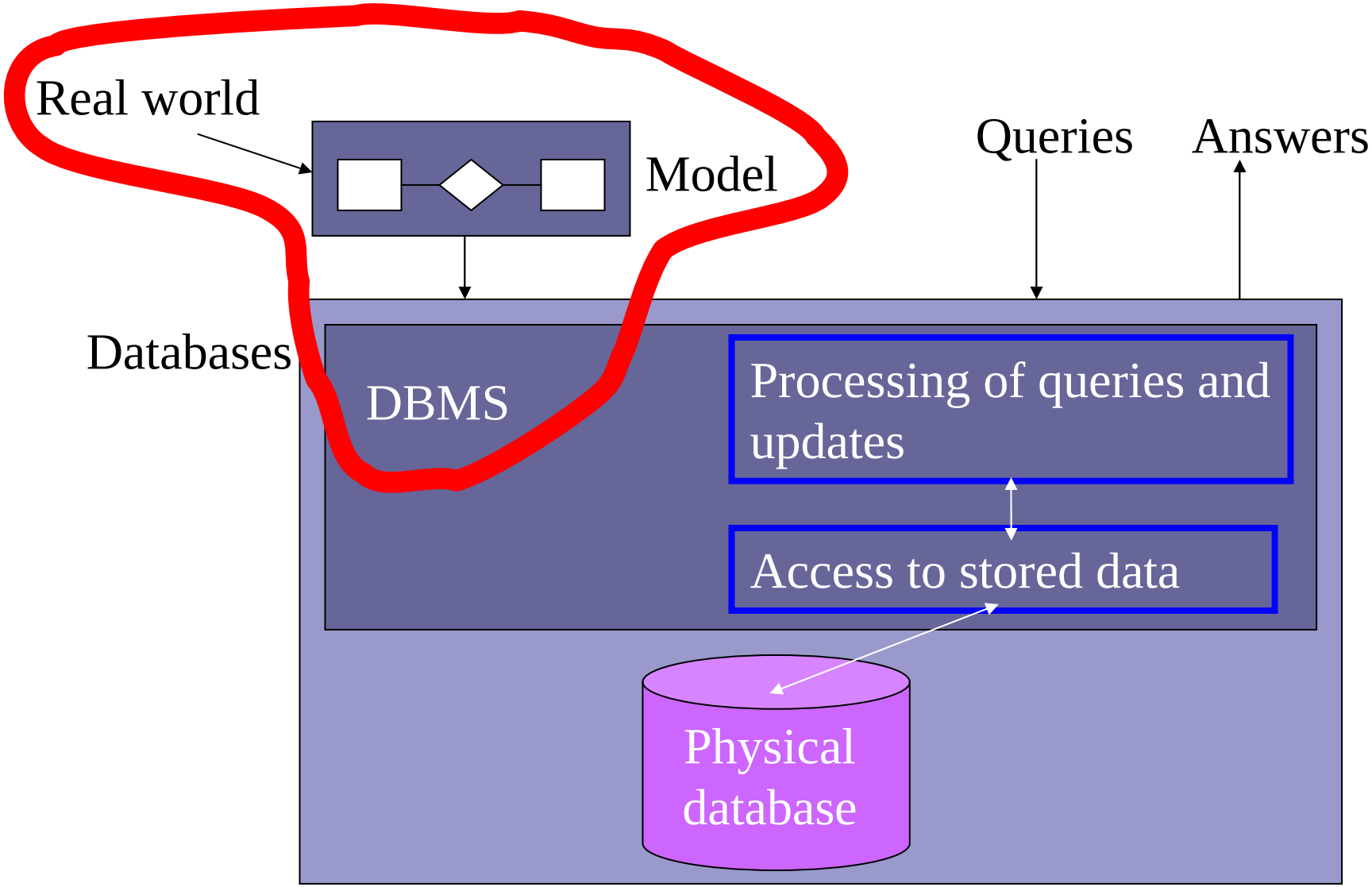
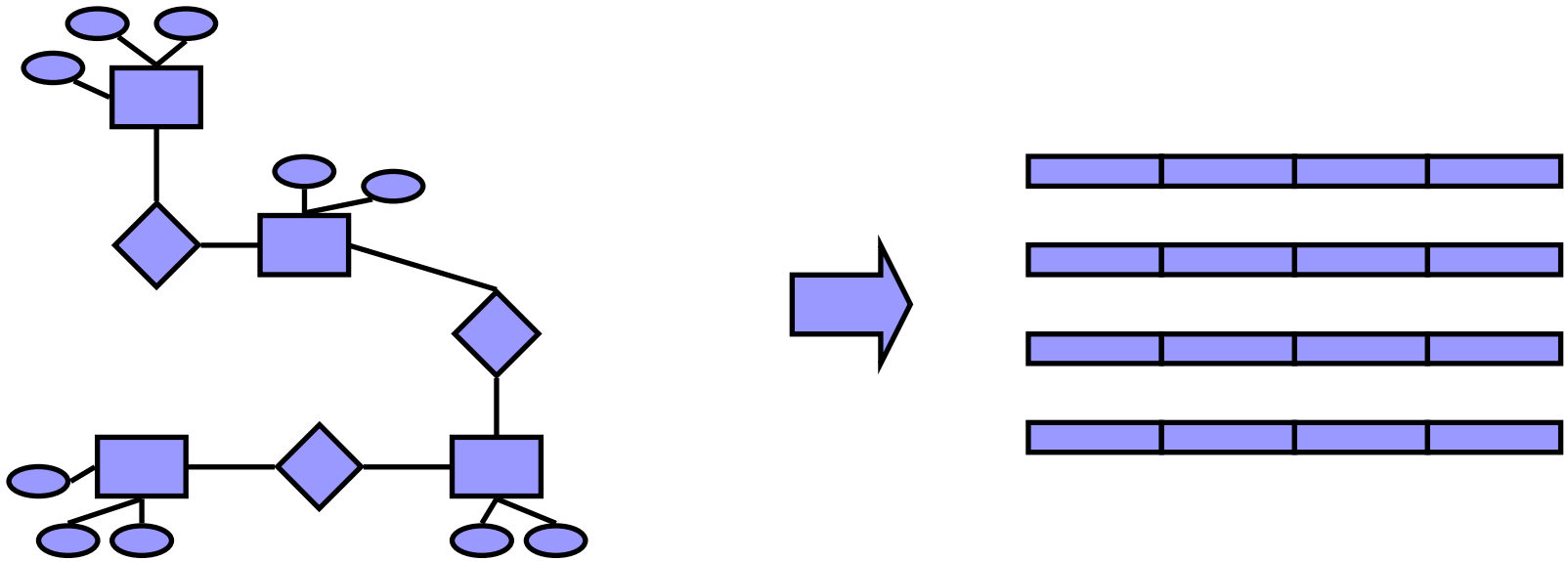
Overview


Real world
Model
Queries
Answers
Databases
DBMS
Processing of queries and updates
Access to stored data
Physical database

Translation ER/EER to Relational

- Migrate from mini world model to a model understandable to a DBMS



EER model for the COMPANY database

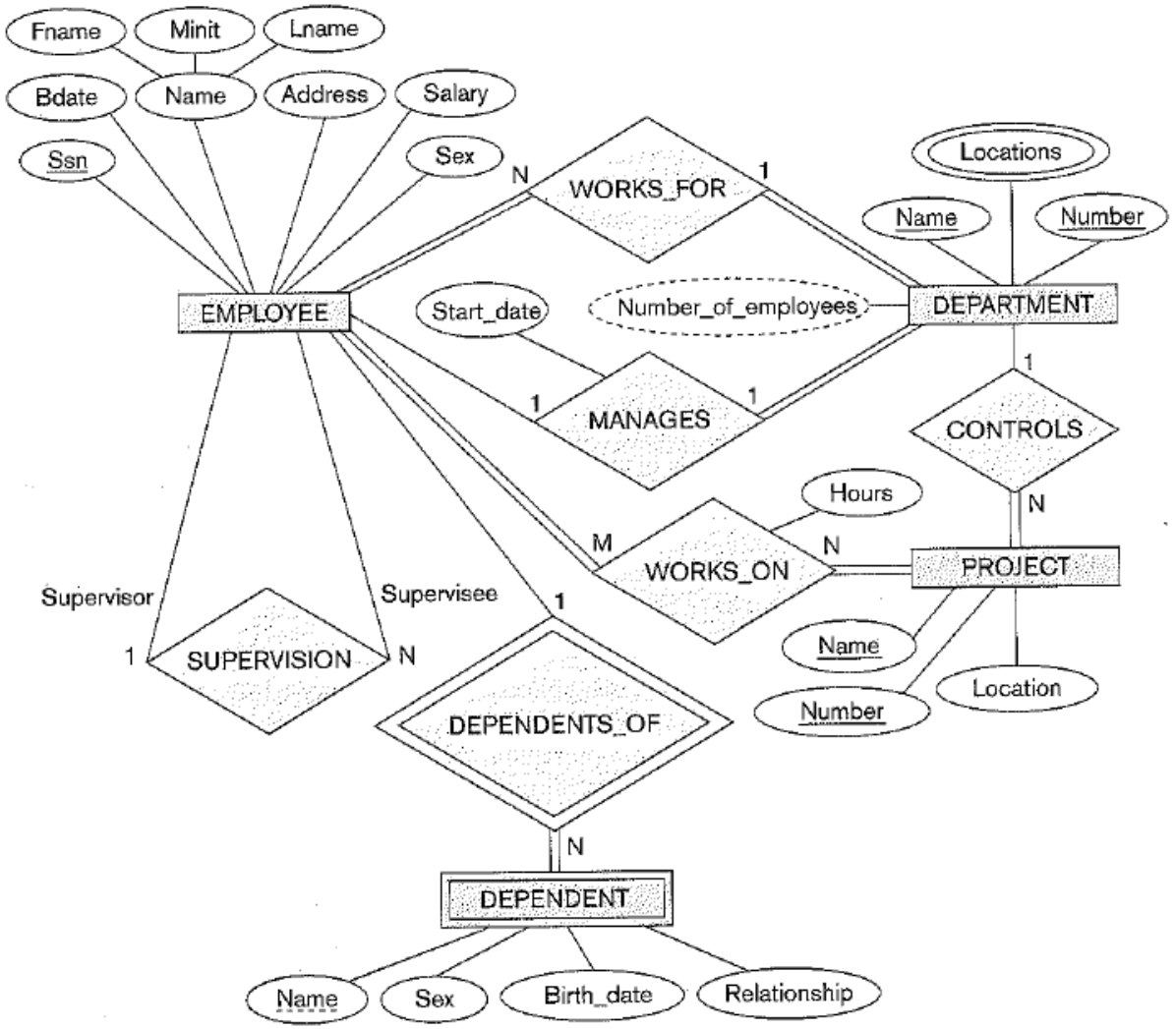
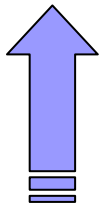


Figure 3.2
An ER schema diagram for the COMPANY database. The diagrammatic notation is introduced gradually throughout this chapter.

ER to Relations

Step 1: Mapping Regular Entity Types

For each strong entity type ***R***, create a relation ***E*** that has the same simple attributes as ***R***.



- **Derived attributes are not stored.**
- **Composite attributes are not stored, their component ones are stored.**
- **Multivalued attributes are treated later.**

PROJECT(Number, Name, Location)

EMPLOYEE(Ssn, Bdate, Fname, Minit, Lname, …)

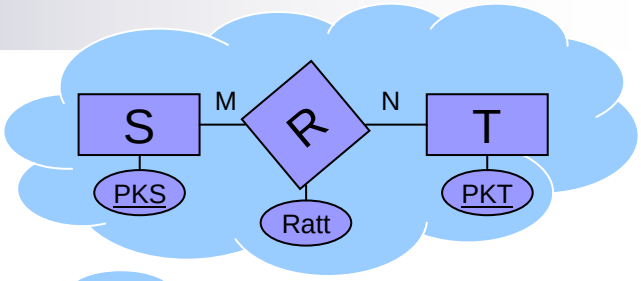
Composite attributes are not stored, their component ones are stored.

DEPARTMENT (Number, Name)

”Number_of_employee”: derived attribute are not stored.

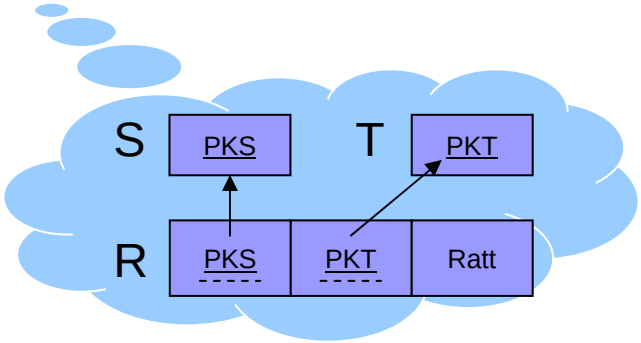
”Location”: multivalued attributes are treated later.

ER to Relations



Step 5: Mapping M:N Relationship Types

For each binary M:N relationship, identify the relations S and T that correspond to the connected entity types. Create a new relation R and use the primary keys from S and T as foreign keys and primary keys in R. If there are attributes on the relation these are also added to R.



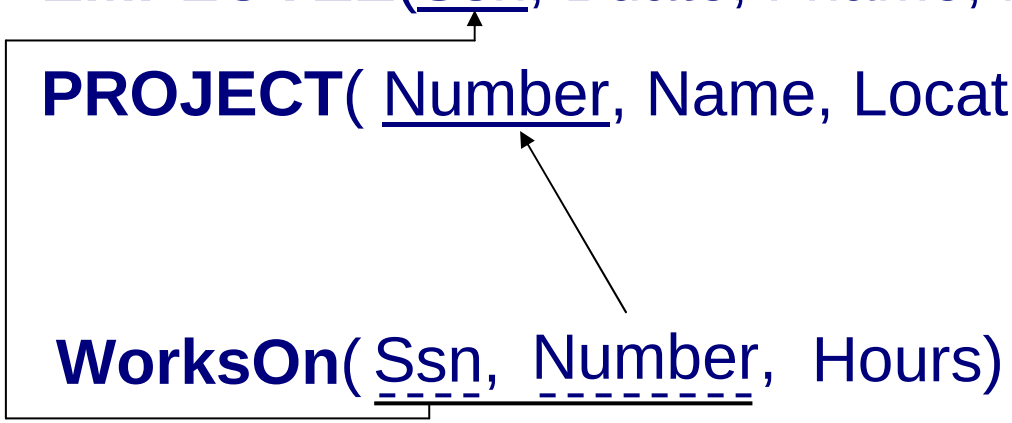
On delete/update CASCADE ?!

DEPARTMENT(Number, Name)

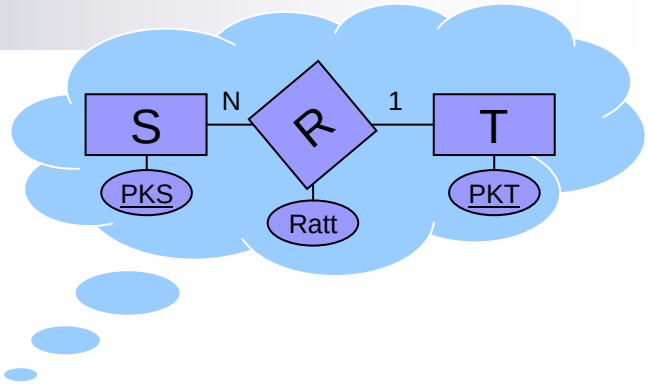
EMPLOYEE(Ssn, Bdate, Fname, Minit, Lname, …)

PROJECT(Number, Name, Location)

WorksOn(Ssn, Number, Hours)



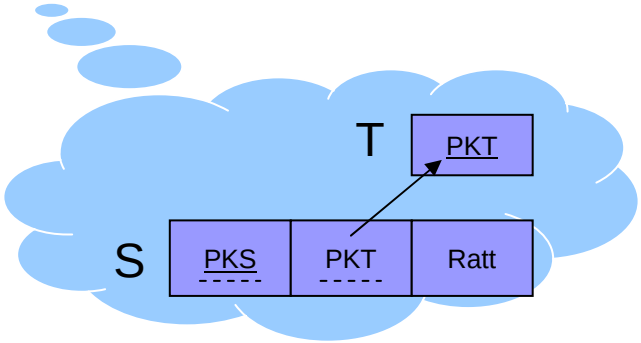
ER to Relations

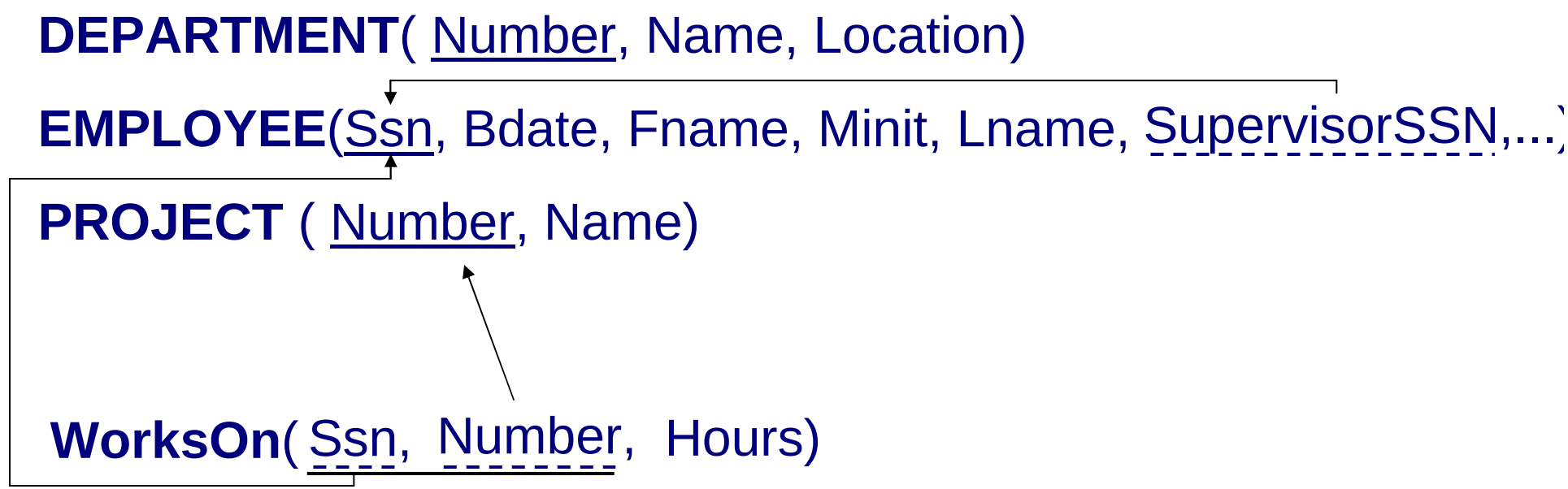


Step 4: Mapping 1:N Relationship Types

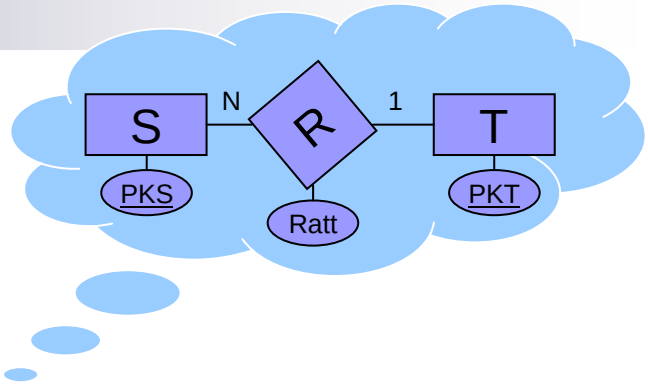
1. For each binary 1:N relationship, identify the relation S that represents the entity type on the *N-side* of the relationship type, and relation T that represents the entity type on the *1-side* of the relationship type. Include as a foreign key in S the primary key of T. If there are attributes on the relation these are also added to S.

On delete/update CASCADE ?!




DEPARTMENT(Number, Name, Location)
EMPLOYEE(Ssn, Bdate, Fname, Minit, Lname, SupervisorSSN,...)
PROJECT (Number, Name)
WorksOn(Ssn, Number, Hours)

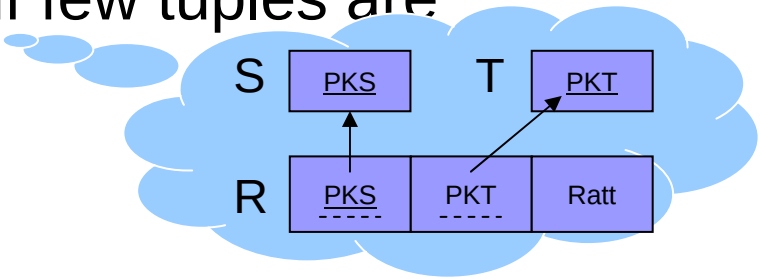
ER to Relations

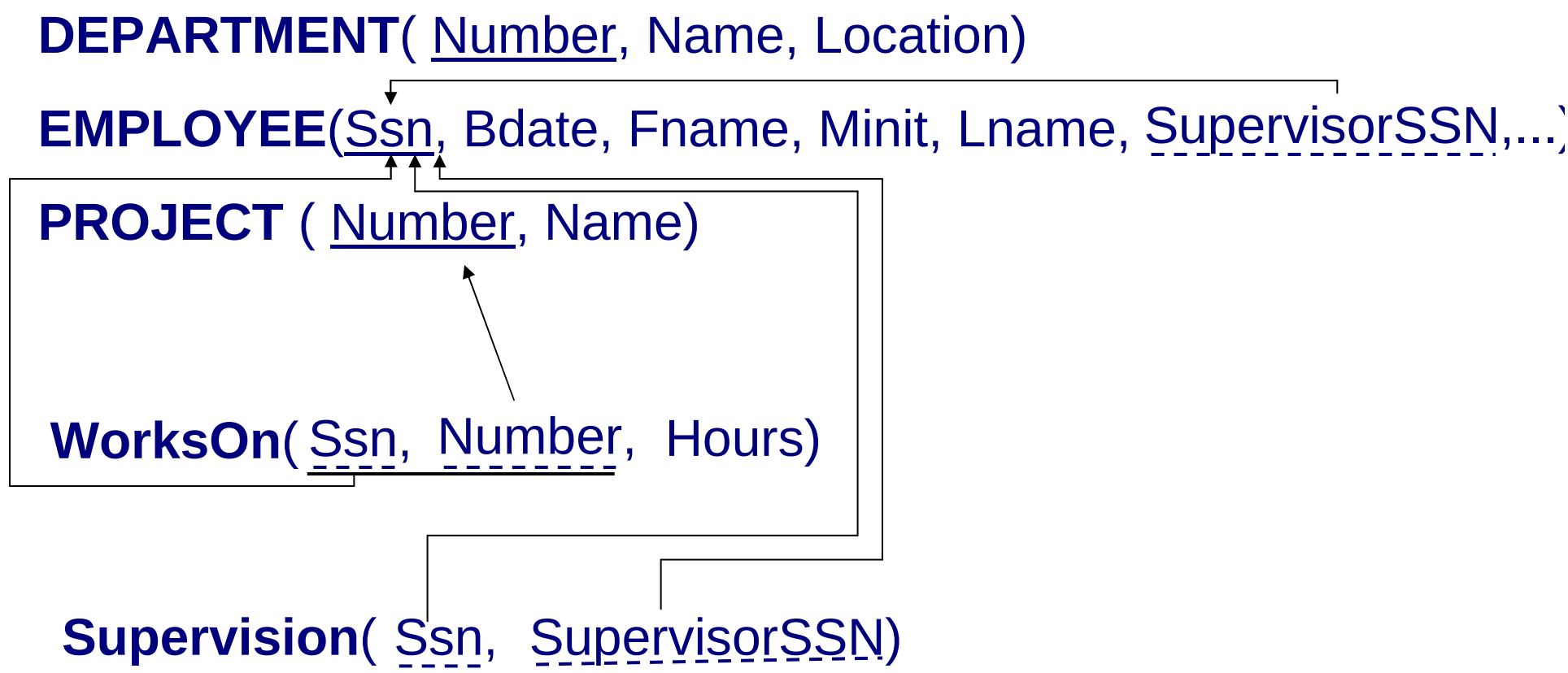


Step 4: Mapping 1:N Relationship Types

1. For each binary 1:N relationship, identify the relation S that represents the entity type on the *N-side* of the relationship type, and relation T that represents the entity type on the *1-side* of the relationship type. Include as a foreign key in S the primary key of T. If there are attributes on the relation these are also added to S.
2. Implement as M:N relationship (unlike M:N relationship, now **PK is PK(S)**). Convenient if few tuples are participate in the relationship.

On delete/update CASCADE ?!




DEPARTMENT(Number, Name, Location)
EMPLOYEE(Ssn, Bdate, Fname, Minit, Lname, SupervisorSSN,...)
PROJECT (Number, Name)
WorksOn(Ssn, Number, Hours)
Supervision(Ssn, SupervisorSSN)

ER to Relations

Step 3: Mapping 1:1 Relationship Types

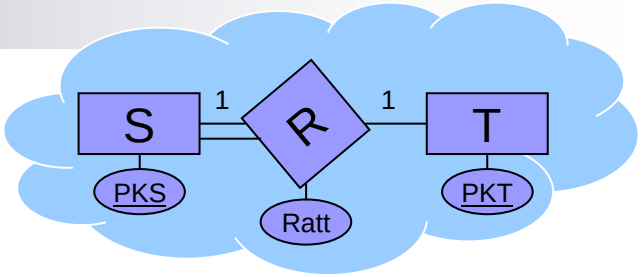
1. Implement as 1:N relationship (prefer the entity type with **total participation**, if any, as the entity type to which the foreign key is added). Convenient if few tuples participate in the relationship.

PROJECT(Number, Name, Location)

EMPLOYEE(Ssn, Bdate, Fname, Minit, Lname, …)

DEPARTMENT (Number, Name, Manager)

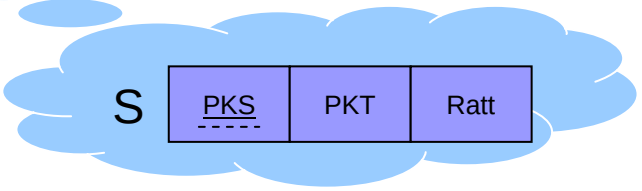
ER to Relations



Step 3: Mapping 1:1 Relationship Types

1. Implement as 1:N relationship (prefer the entity type with **total participation**, if any, as the entity type to which the foreign key is added). Convenient if few tupies participate in the relationship.

2. For each binary 1:1 relationship B, identify the relations S and T that correspond to the incoming entity types. Merge S and T into a single relation R. Set the primary key of S or T as the primary key of R. Do not forget the attributes of the relationship type. **Indicated only when S and/or T with total participation.**



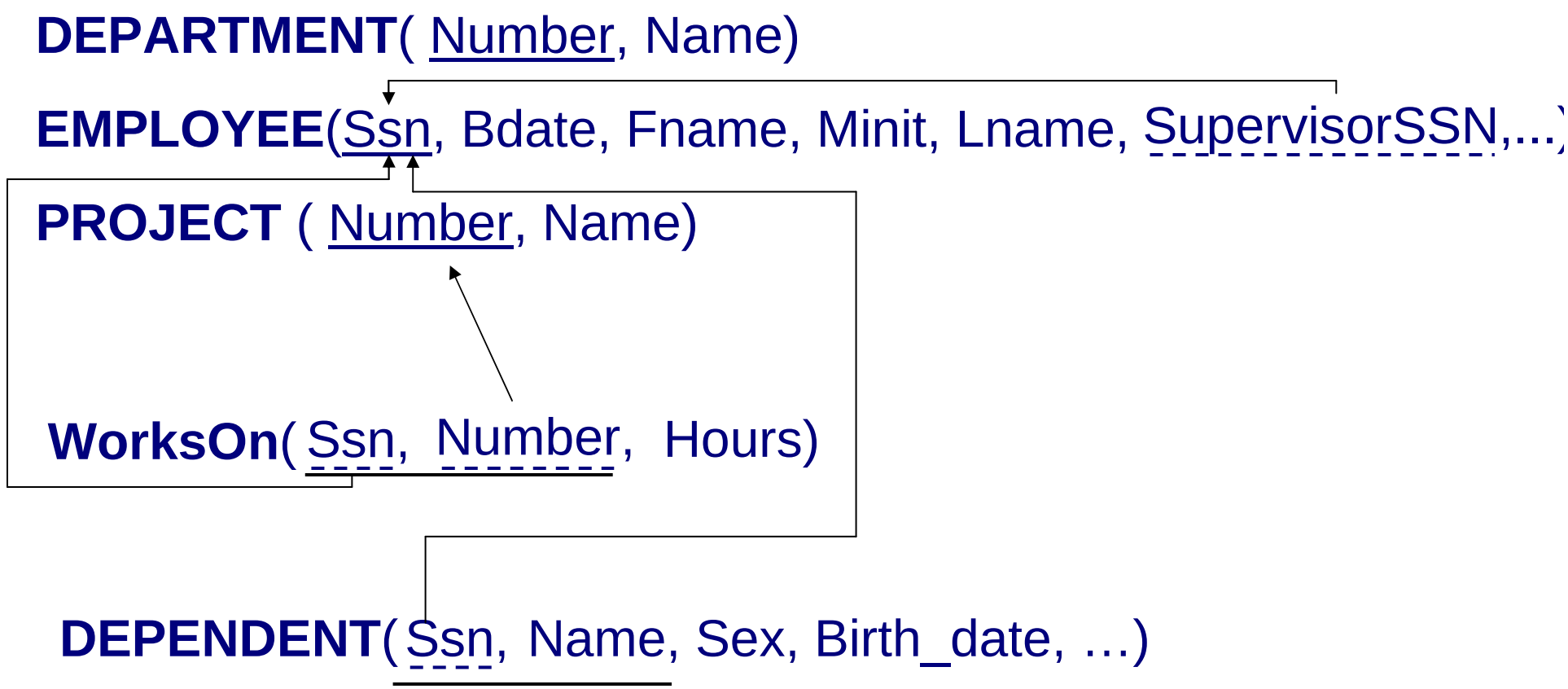
ER to Relations

Step 2: Mapping Weak Entity Types

For each weak entity type ***W*** with owner entity type ***E***, create a relation ***R*** that has the same simple attributes as ***W***, also add (as a foreign key) the primary key attributes from the relation that corresponds to ***E***.

Primary key attributes in R are composed of the primary key attributes from E and the partial key from W.

On delete/update CASCADE ?!


DEPARTMENT(Number, Name)
EMPLOYEE(Ssn, Bdate, Fname, Minit, Lname, SupervisorSSN,...)
PROJECT (Number, Name)
WorksOn(Ssn, Number, Hours)
DEPENDENT(Ssn, Name, Sex, Birth_date, …)

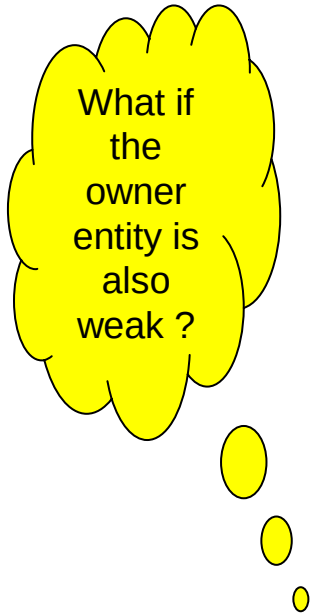
ER to Relations

Step 2: Mapping Weak Entity Types

For each weak entity type ***W*** with owner entity type ***E***, create a relation ***R*** that has the same simple attributes as ***W***, also add (as a foreign key) the primary key attributes from the relation that corresponds to ***E***.

Primary key attributes in R are composed of the primary key attributes from E and the partial key from W.

On delete/update CASCADE ?!



ER to Relations

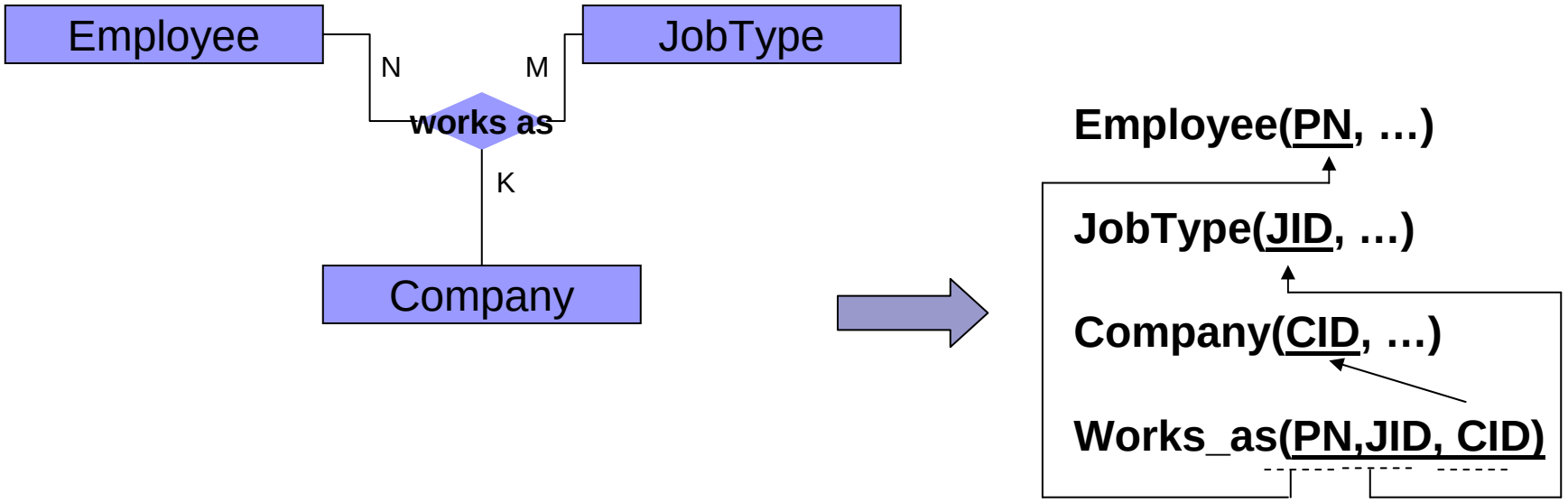
Step 7: Mapping N-ary Relationship Types

For each N-ary relationship with N>2, create a new relation S that contains the primary keys from the incoming relations as foreign keys. Primary key of S are those keys that come from cardinality constraints ≠ 1. Do not forget the attributes of the relationship type.

On delete/update CASCADE ?!

N-ary relationships

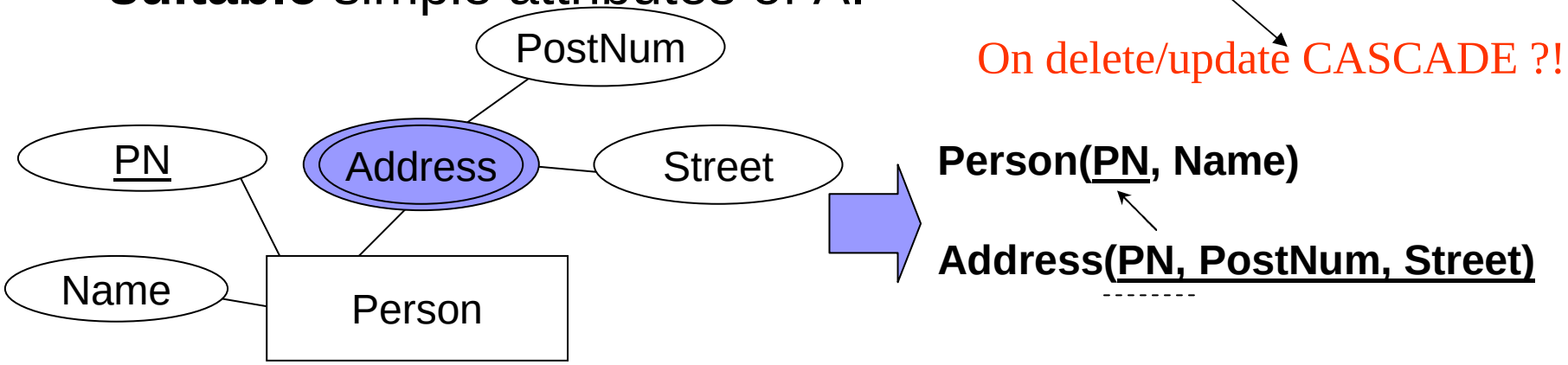
- Example. A person works as an engineer at one company and as a gym instructor at another company.



ER to Relations

Step 6: Mapping multivalued attributes

For each multivalued attribute A in R, create a new relation P that contains one attribute for each attribute in A and the primary key K of R as a foreign key. The primary key of P is the combination of K and **some suitable** simple attributes of A.



ER to Relations

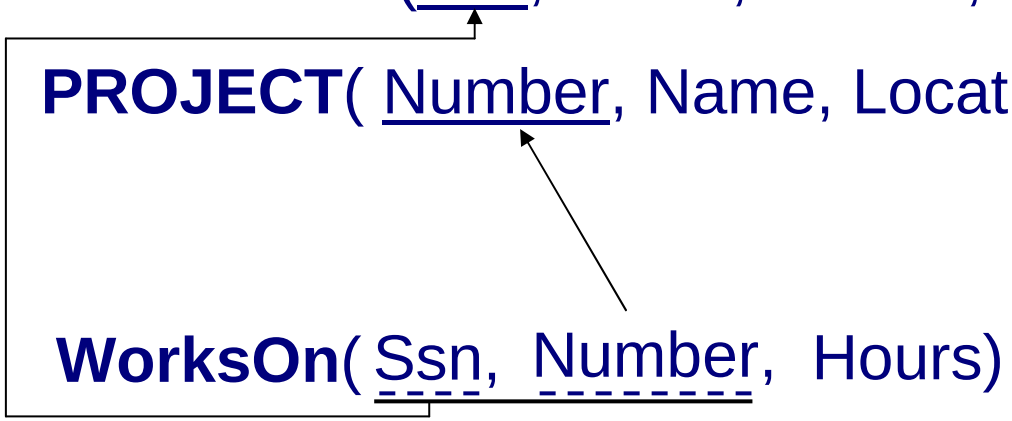
- Materializing the relationship:
  - M:N implies two joins
  - 1:N implies one or two joins
  - 1:1 implies zero, one or two joins
  - N-ary implies N joins.

DEPARTMENT(Number, Name)

EMPLOYEE(Ssn, Bdate, Fname, Minit, Lname, …)

PROJECT(Number, Name, Location)

WorksOn(Ssn, Number, Hours)



SELECT *E.Fname, P.Name, W.Hours*
FROM *EMPLOYEE E, PROJECT P, WorksOn W*
WHERE *W.SSN = E.SSN* **AND** *W.Number = P.Number*

ER to Relations

- Materializing the relationship:
  - M:N implies two joins
  - 1:N implies one or two joins
  - 1:1 implies zero, one or two joins
  - N-ary implies N joins.

PROJECT(Number, Name, Location)

EMPLOYEE(Ssn, Bdate, Fname, Minit, Lname, …)

DEPARTMENT (Number, Name, Manager)

SELECT *E.Fname, D.Name*

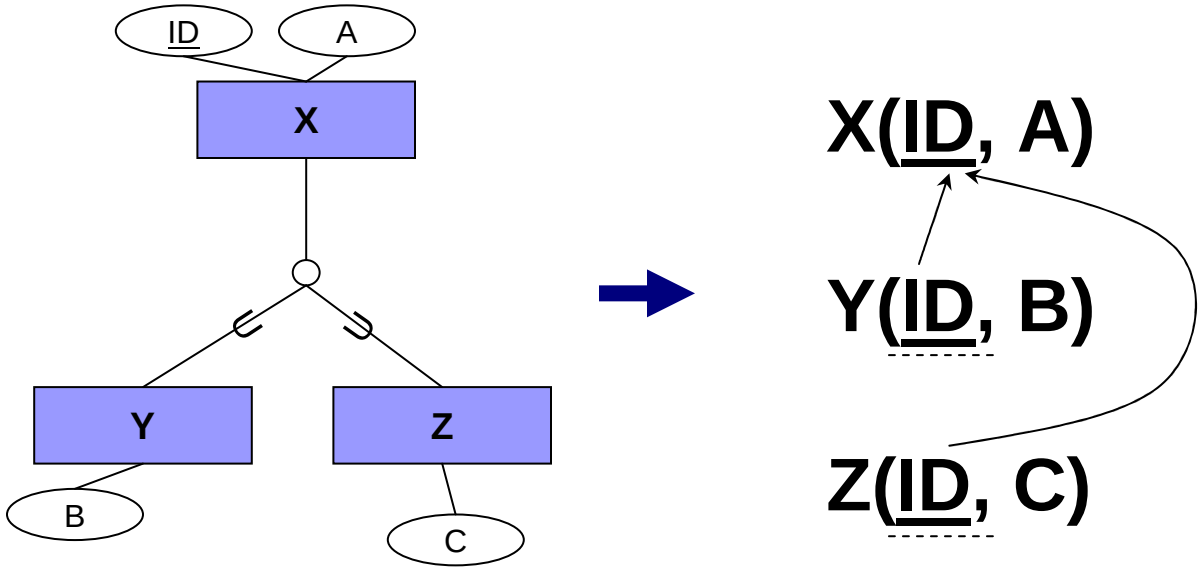
FROM *EMPLOYEE E, DEPARTMENT D*

WHERE *D.Manager = E.Ssn*;

EER to Relations

Step 8: Mapping Specialization

a) create relations for each class (super+sub)

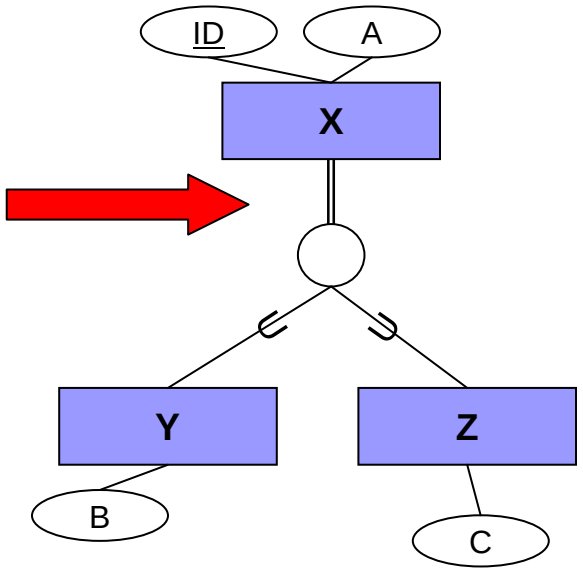


*** Always works.**

EER to Relations

Step 8: Mapping Specialization

b) subclass relations only



Y(ID, A, B)

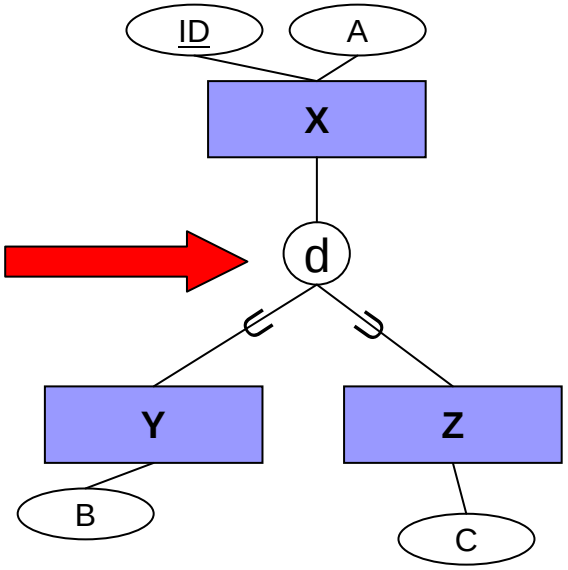
Z(ID, A, C)

*** Works only for total participation.**
*** Overlapping implies duplication.**

EER to Relations

Step 8: Mapping Specialization

c) single relation with one type attribute and all subclass attributes



No needed if specialization is attribute-defined.

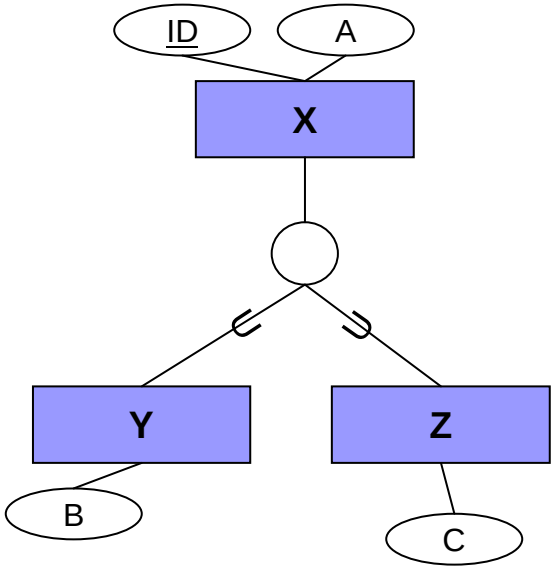
X(ID, A, Type, B, C)

*** Works only for disjoint subclasses.**
*** May produce many NULLs if many subclass-specific attributes exist.**

EER to Relations

Step 8: Mapping Specialization

d) single relation with multiple type attributes and all subclass attributes



→ **X(<u>ID</u>, A, IsY, B, IsZ, C)**

*** Always works.**
*** May produce many NULLs if many subclass-specific attributes exist.**

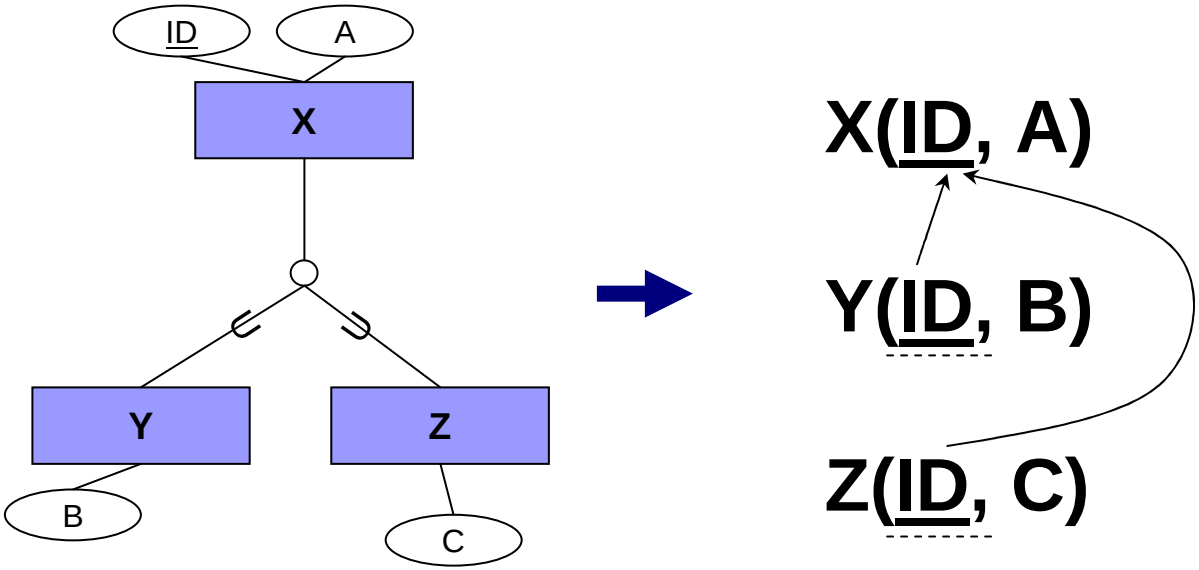
EER to Relations

- Materializing the superclass/subclasses
  - Option a, inner/outer join.
  - Option b, outer join (against theory…).
  - Option c, done.
  - Option d, done.

May be more space inefficient but more time efficient.

EER to Relations

a) create relations for each class (super+sub)

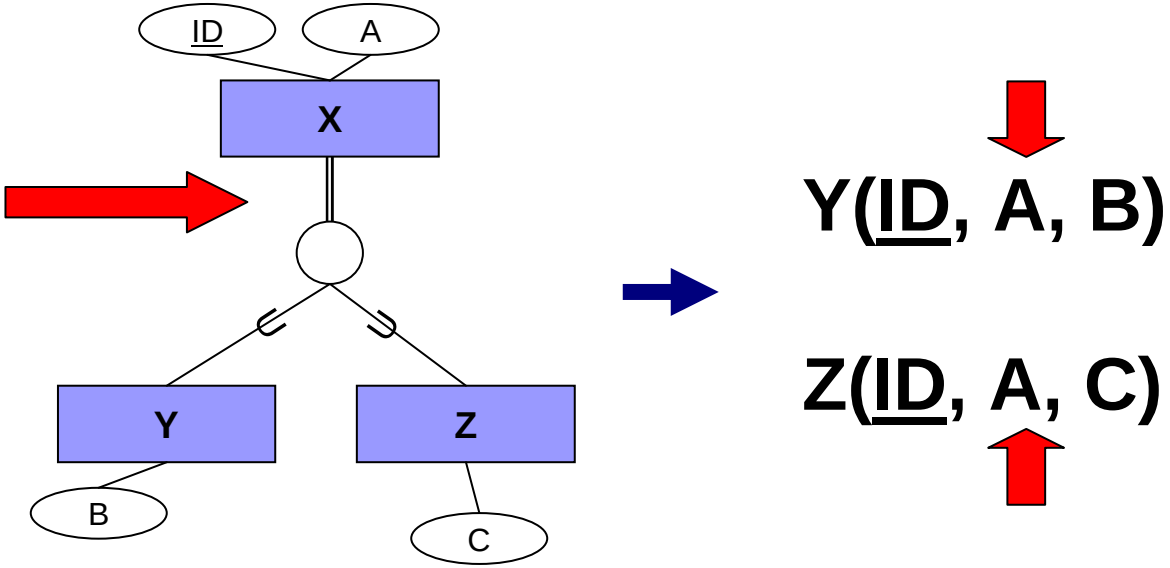


SELECT *X.ID, X.A, Y.B*

FROM *X* **LEFT JOIN** *Y* **ON** *X.ID* = *Y.ID*;

EER to Relations

b) subclass relations only

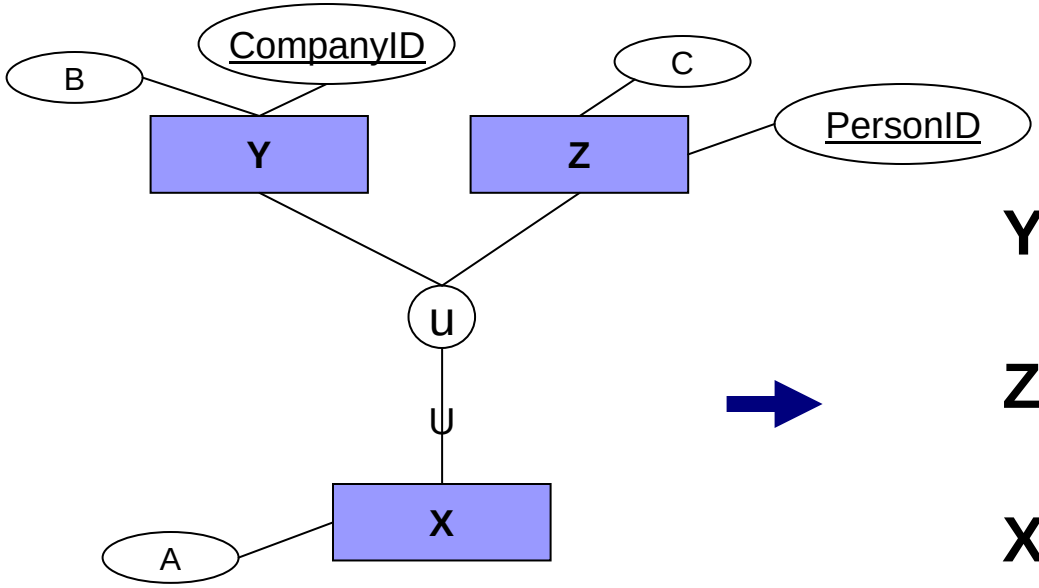


SELECT *Y.ID, Z.ID, Y.A, Z.A,Y.B, Z.C*
FROM *Y* **FULL OUTER JOIN** *Z* **ON** *Y.ID = Z.ID*;

EER to Relations

Step 9: Mapping of Union Types

a) If the defining superclasses have different primary keys, introduce a surrogate key in the union relation and use it as a foreign key in the superclasses.



Y(CompanyID, B, XID)

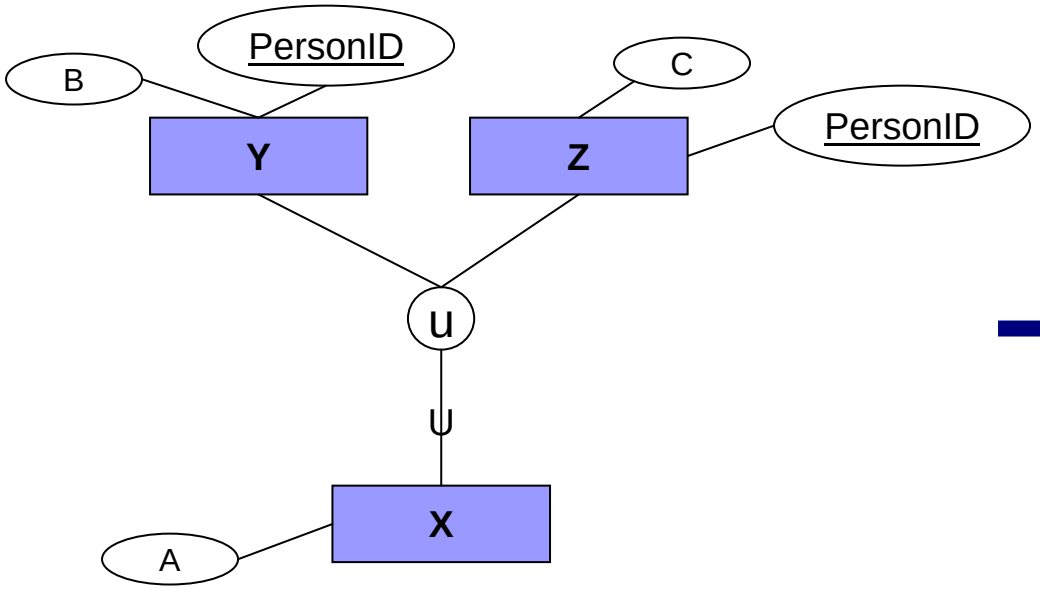
Z(PersonID, C, XID)

X(XID, A)

EER to Relations

Step 9: Mapping of Union Types

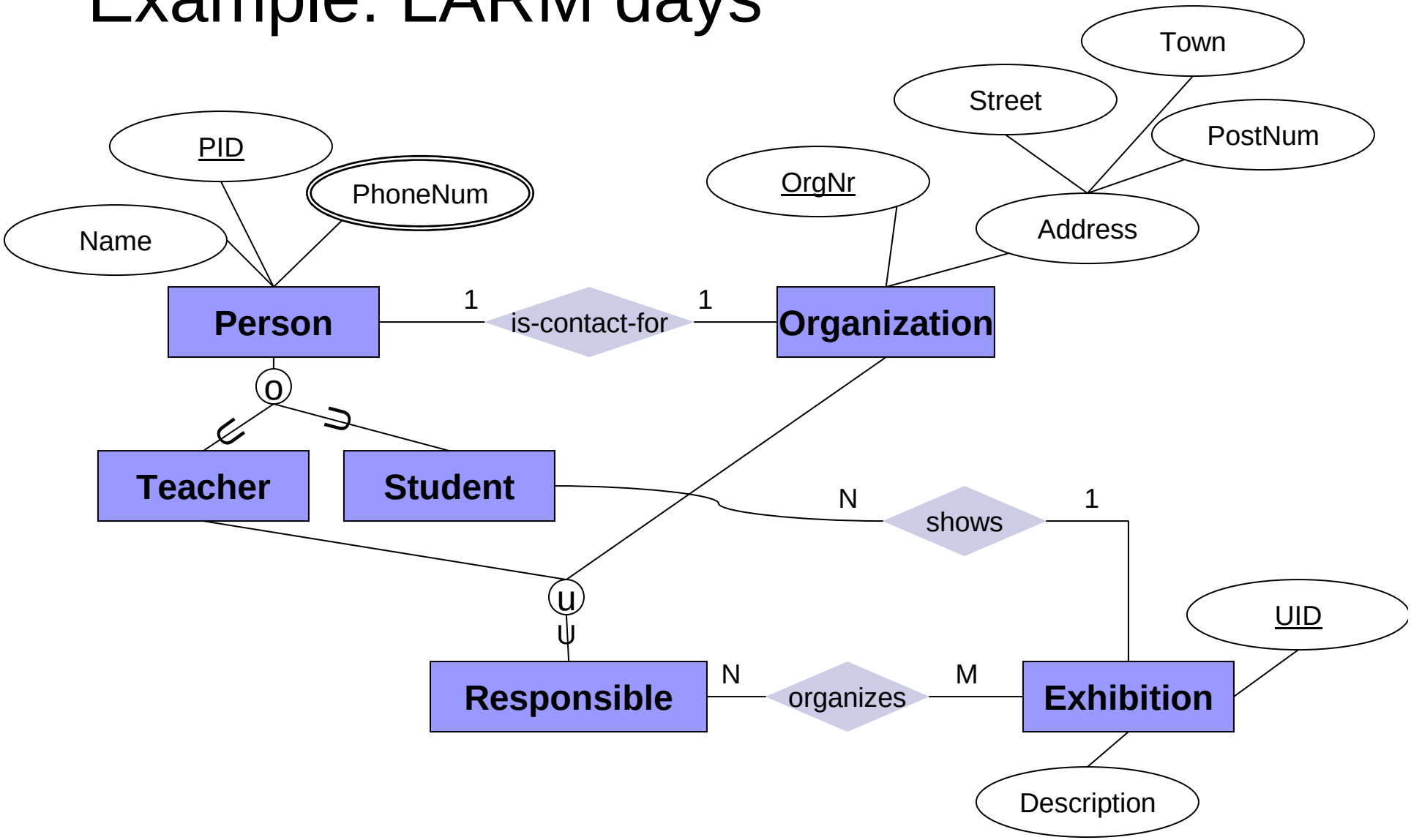
b) If the defining superclasses use the same primary key, no need for surrogate key.



Y(PersonID, B)

Z(PersonID, C)

X(PersonID, A)

*** No FKs in Y and Z, unless total participation (correct figure 7.7 in the book)**

Example: LARM days