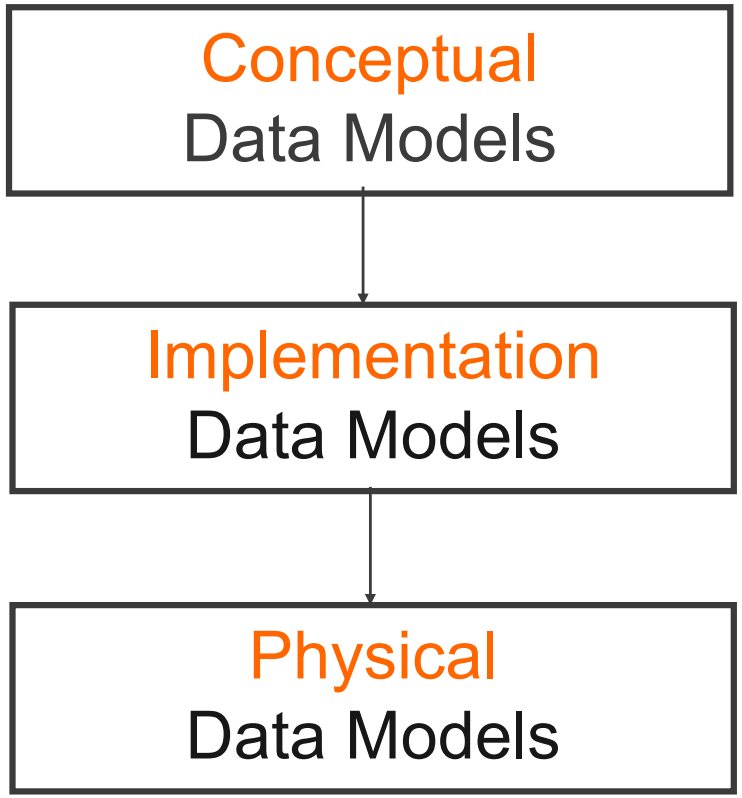
ER-Relational Mapping

政治大學
資訊科學系
沈錳坤

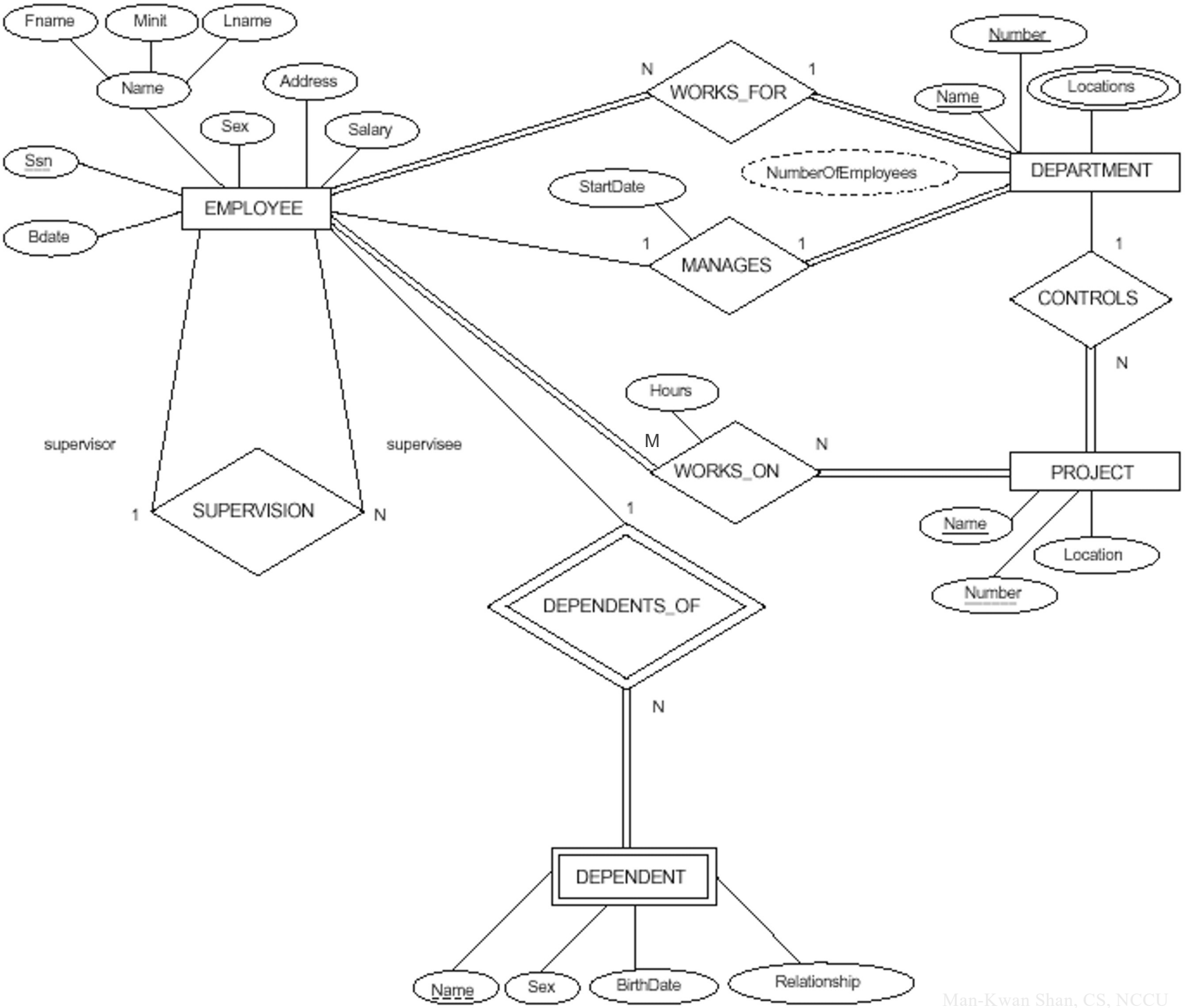
Data Models



Entity-Relationship Model

ER to Relational Mapping

Relational Data Model
SQL, Relational Algebra
Normalization


Fname
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Lname
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Address
Sex
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EMPLOYEE
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WORKS_FOR
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Locations
DEPARTMENT
NumberOfEmployees
StartDate
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MANAGES
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CONTROLS
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Hours
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WORKS_ON
PROJECT
Name
Location
Number
supervisor
supervisee
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SUPERVISION
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1
DEPENDENTS_OF
N
DEPENDENT
Name
Sex
BirthDate
Relationship

EMPLOYEE

FNAME	MINIT	LNAME	SSN	BDATE	ADDRESS	SEX	SALARY	SUPERSSN	DNO

DEPARTMENT

DNAME	DNUMBER	MGRSSN	MGRSTARTDATE

DEPT_LOCATIONS

DNUMBER	DLOCATION

PROJECT

PNAME	PNUMBER	PLOCATION	DNUM

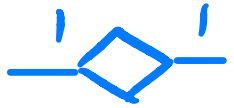
WORKS_ON

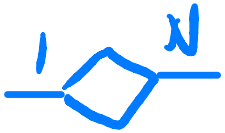
ESSN	PNO	HOURS

DEPENDENT

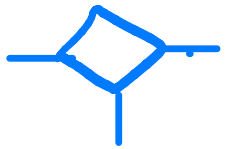
ESSN	DEPENDENT_NAME	SEX	BDATE	RELATIONSHIP

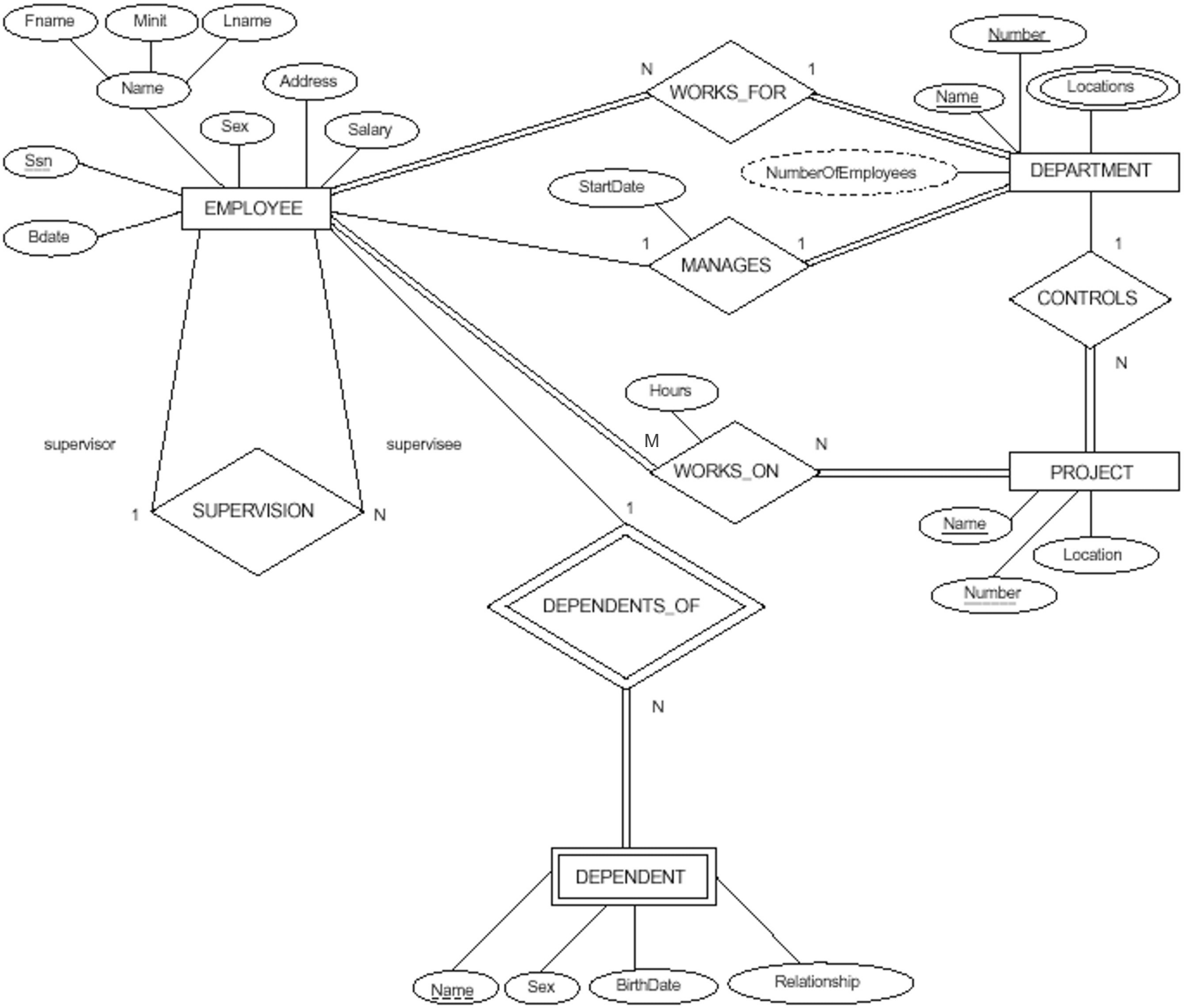
ER-to-Relational Mapping Algorithm

- Step 1: for each regular entity type E 
- Step 2: for each weak entity type W 
- Step 3: for each binary 1:1 relationship type R 

- Step 4: for each binary 1:N relationship type R 

- Step 5: for each binary M:N relationship type R 

- Step 6: for each multivalued attribute A 
- Step 7: for each n-ary relationship type, n>2 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Sex
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EMPLOYEE
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Locations
DEPARTMENT
NumberOfEmployees
StartDate
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PROJECT
Name
Location
Number
supervisor
supervisee
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SUPERVISION
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DEPENDENTS_OF
N
DEPENDENT
Name
Sex
BirthDate
Relationship

Step 1

- Step 1: for each regular entity type E
  - Create a relation R
  - Include all simple attributes of E : break composite into simple
  - Include only the simple component attributes of a composite attribute
  - Choose one of key attributes of E as primary key for R

- Ex.
  - Create relation employee, primary key SSN
  - Create relation department, primary key Dnumber
  - Create relation project, primary key Pnumber

EMPLOYEE

FNAME	MINIT	LNAME	SSN	BDATE	ADDRESS	SEX	SALARY	SUPERSSN	DNO

DEPARTMENT

DNAME	DNUMBER	MGRSSN	MGRSTARTDATE

DEPT_LOCATIONS

DNUMBER	DLOCATION

PROJECT

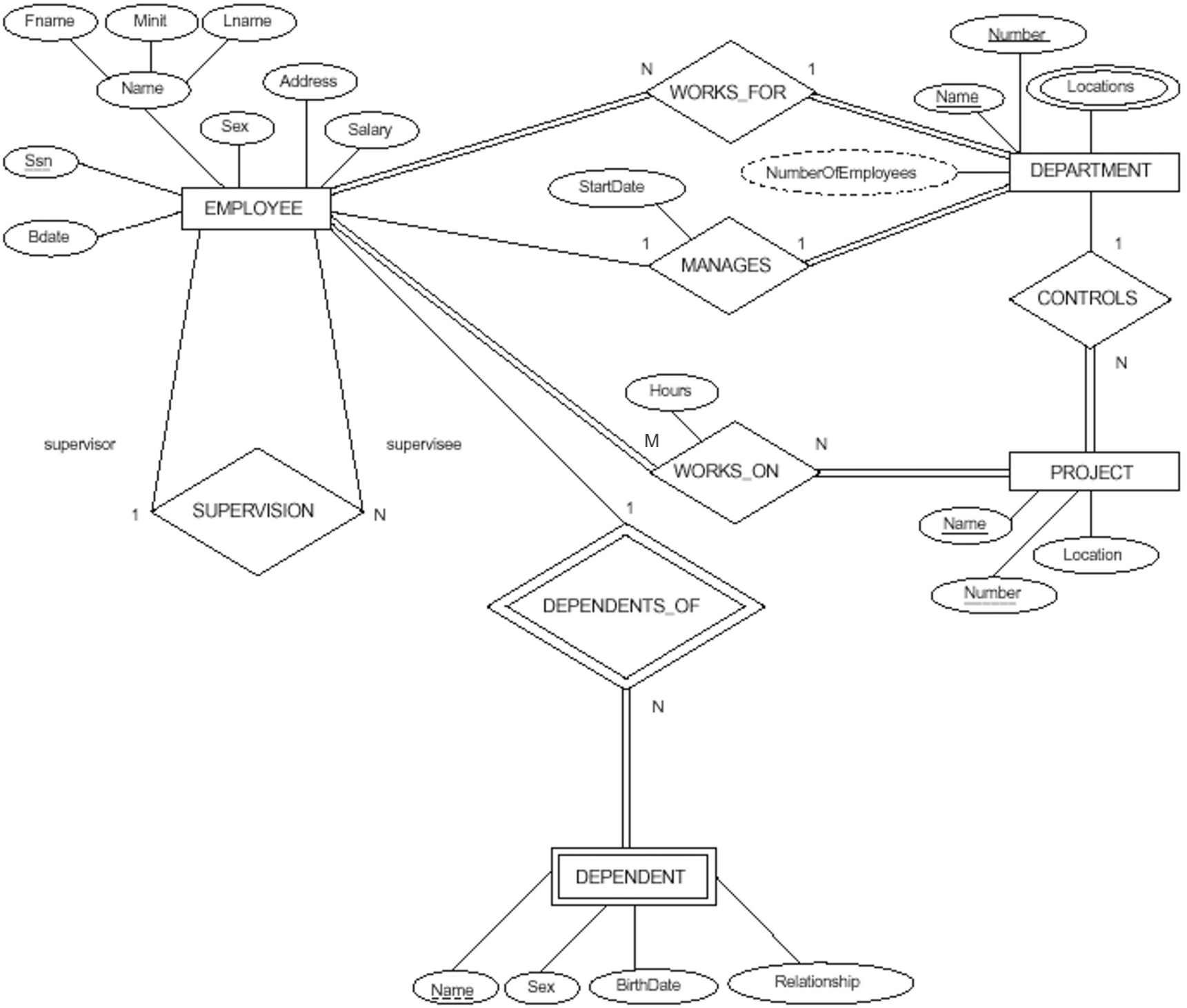
PNAME	PNUMBER	PLOCATION	DNUM

WORKS_ON

ESSN	PNO	HOURS

DEPENDENT

ESSN	DEPENDENT_NAME	SEX	BDATE	RELATIONSHIP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NumberOfEmployees
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Location
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supervisor
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SUPERVISION
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DEPENDENTS_OF
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DEPENDENT
Name
Sex
BirthDate
Relationship

Step 2

- Step 2: for each weak entity type W with owner E
  - Create relation R
  - Include all simple attributes of W as attributes of R
  - Include primary key of relations that correspond to owner entity type as foreign key of R
  - Primary key of R = (primary key of owner, partial key of W)
- Ex.
  - Create relation Dependent
  - Include SSN as foreign key of Dependent
  - Primary key of Dependent (ESSN, Dependent_Name)
  - Choose Cascade option for the referential constraint on this foreign key

EMPLOYEE

FNAME	MINIT	LNAME	SSN	BDATE	ADDRESS	SEX	SALARY	SUPERSSN	DNO

DEPARTMENT

DNAME	DNUMBER	MGRSSN	MGRSTARTDATE

DEPT_LOCATIONS

DNUMBER	DLOCATION

PROJECT

PNAME	PNUMBER	PLOCATION	DNUM

WORKS_ON

ESSN	PNO	HOURS

DEPENDENT

ESSN	DEPENDENT_NAME	SEX	BDATE	RELATIONSHIP

ER-to-Relational Mapping Algorithm

Step 1: for each regular entity type E

Step 2: for each weak entity type W

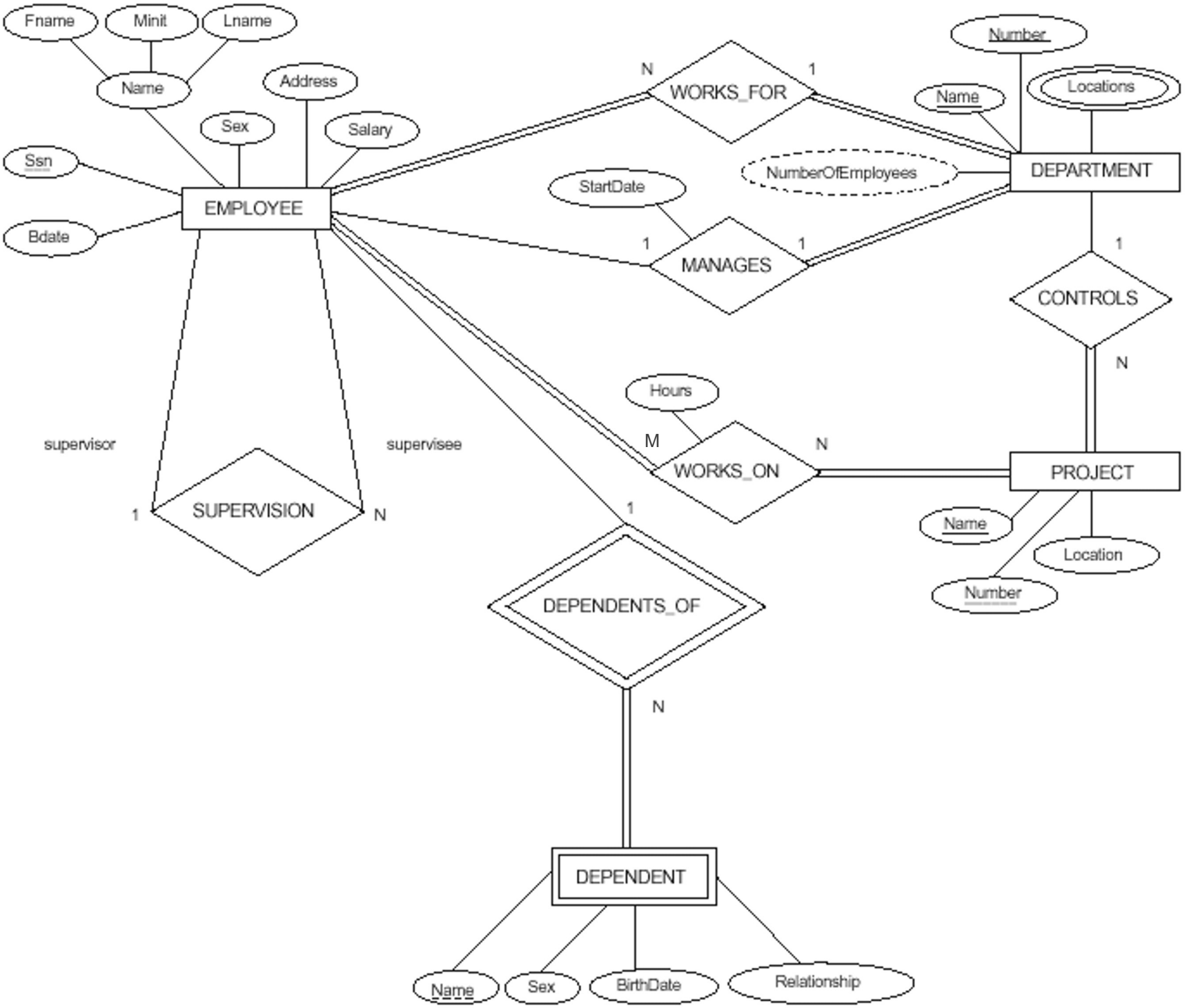
Step 3: for each binary 1:1 relationship type R

Step 4: for each binary 1:N relationship type R

Step 5: for each binary M:N relationship type R

Step 6: for each multivalued attribute A

Step 7: for each n-ary relationship type, n>2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NumberOfEmployees
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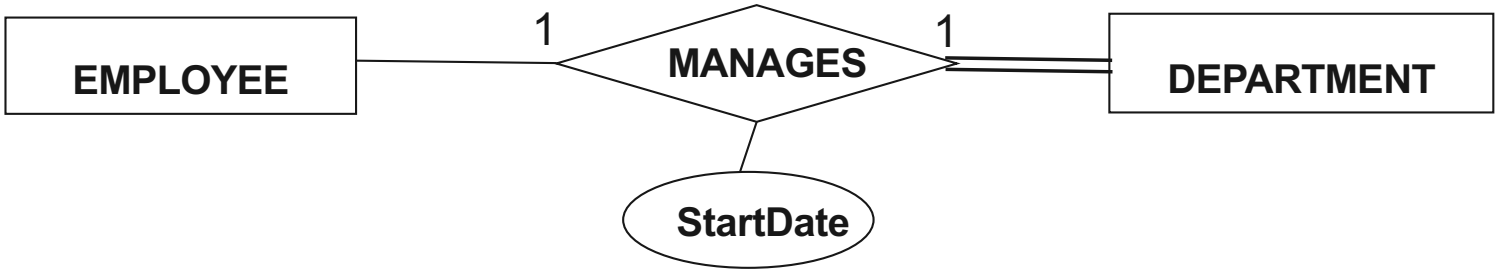
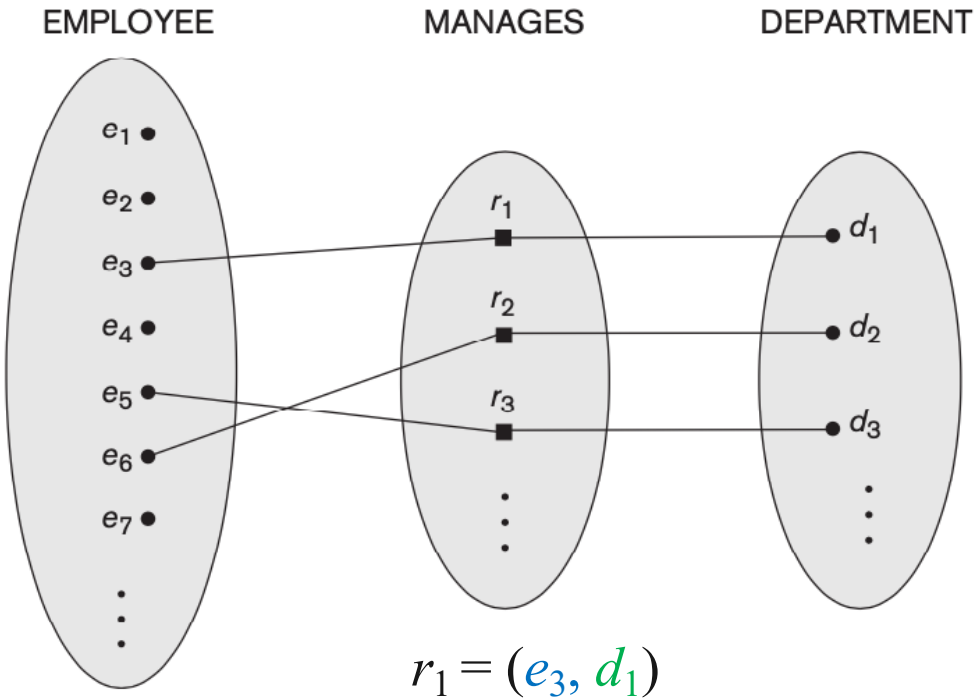
Sex
BirthDate
Relationship





$r_1 = (e_3, d_1)$

$r_2 = (e_6, d_2)$

$r_3 = (e_5, d_3)$

EMPLOYEE

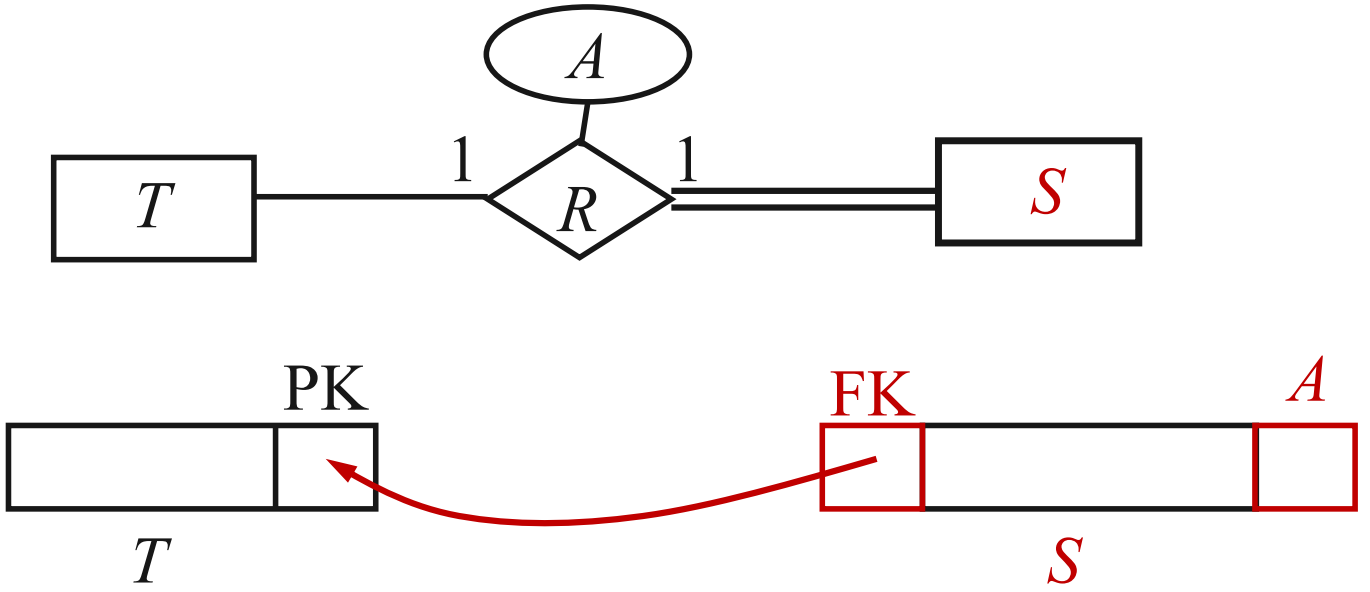
SSN	…	ENo	DNo
123456789	…	e_1	
999887777	…	e_2	
333445555	…	e_3	d_1
666884444	…	e_4	
888665555	…	e_5	d_3
987654321	…	e_6	d_2
453453453	…	e_7	

DEPARTMENT

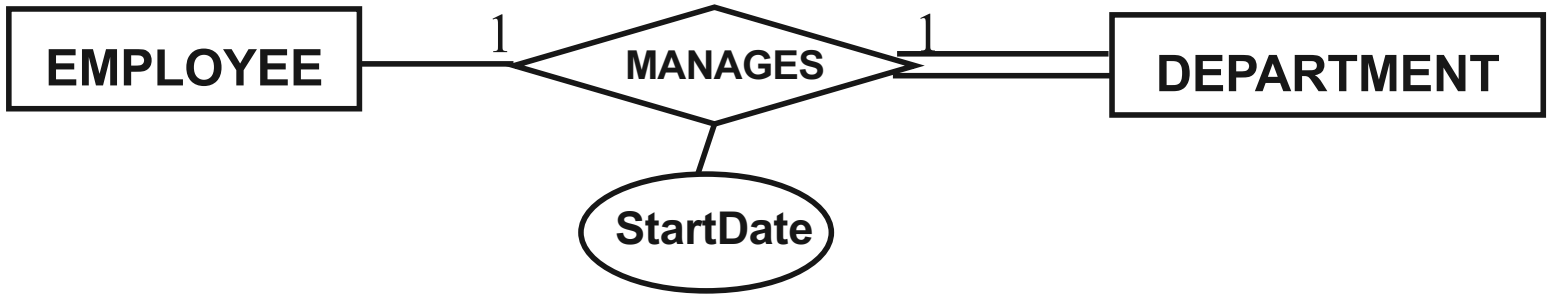
ENo	DNo	…	Dname
e_3	d_1	…	Research
e_5	d_3	…	Administration
e_6	d_2	…	Headquarters

Step 3

- Step 3: for each binary 1:1 relationship type *R*
  - Identify relation *S* with total participation
  - Include the primary key of *T* as foreign key in *S*
  - Include all simple attributes of R as attributes of S



Step 3

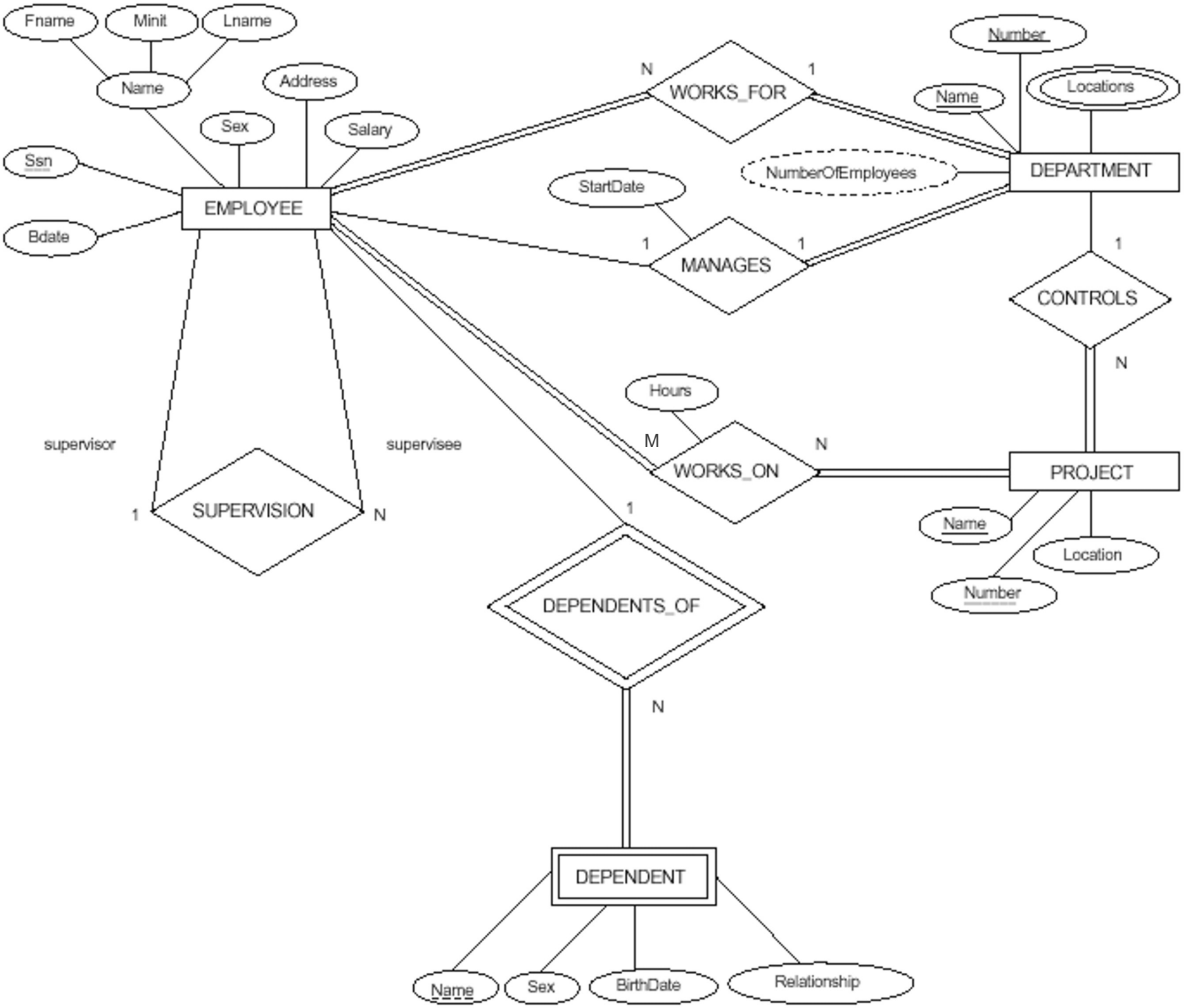


DEPARTMENT

Dname	Dnumber	Mgr_ssn	Mgr_start_date

EMPLOYEE

Fname	Minit	Lname	Ssn	Bdate	Address	Sex	Salary	Super_ssn	Dno


Fname
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Sex
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EMPLOYEE
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WORKS_FOR
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Locations
DEPARTMENT
NumberOfEmployees
StartDate
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MANAGES
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CONTROLS
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Hours
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WORKS_ON
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PROJECT
Name
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supervisor
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DEPENDENTS_OF
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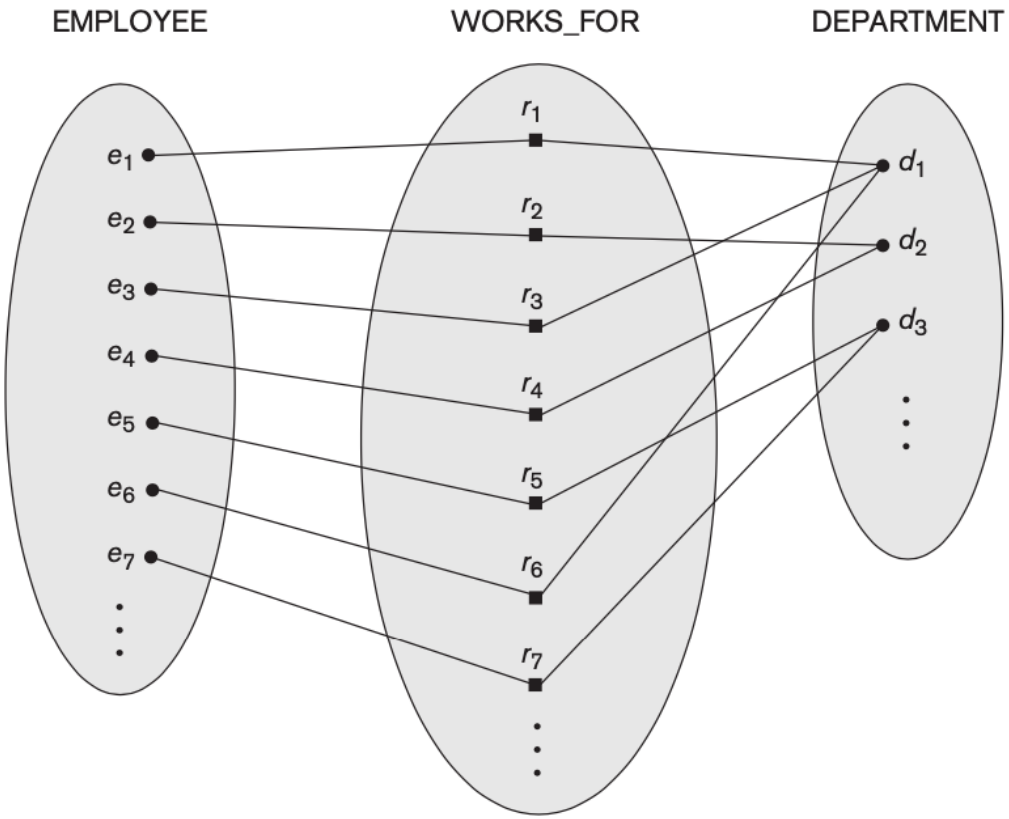
DEPENDENT
Name
Sex
BirthDate
Relationship



EMPLOYEE

SSN	…	ENo	DNo
123456789	…	e_1	d_1
999887777	…	e_2	d_2
333445555	…	e_3	d_1
666884444	…	e_4	d_2
888665555	…	e_5	d_3
987654321	…	e_6	d_1
453453453	…	e_7	d_3

r1 = (e1, d1)
r2 = (e2, d2)
r3 = (e3, d1)
r4 = (e4, d2)
r5 = (e5, d3)
r6 = (e6, d1)
r7 = (e7, d3)

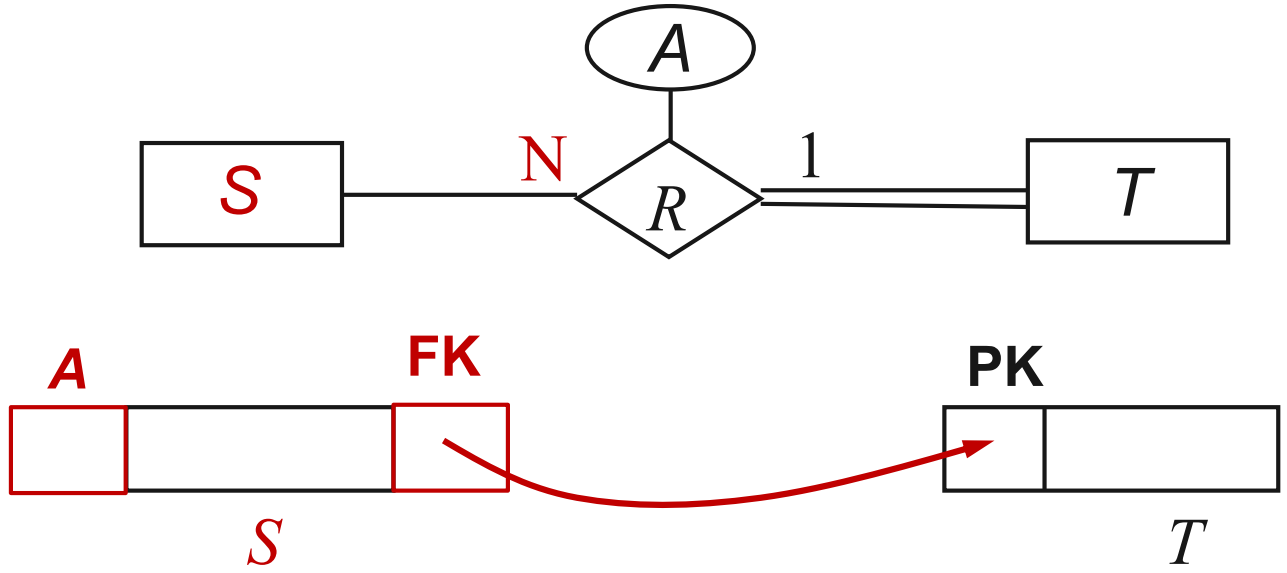
DEPARTMENT

DNo	ENo	…	Dname
d_1	e_1, e_3, e_6	…	Research
d_3	e_5, e_7	…	Administration
d_2	e_2, e_4	…	Headquarters

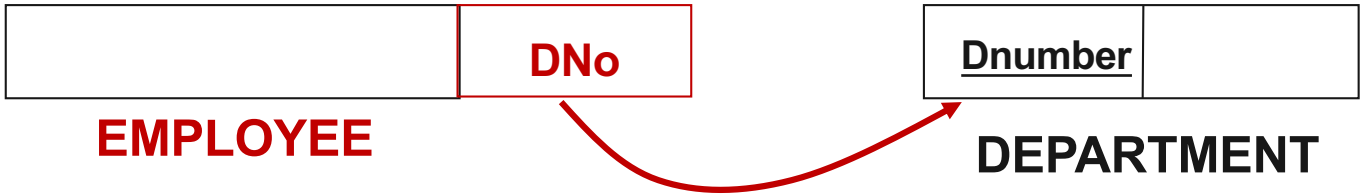
Multi-value

Step 4

- Step 4: for each binary 1:N relationship type *R*
  - Identify relation *S* at the N-side of relationship
  - Include primary key of relation *T* (the other side) as foreign key in *S*
  - Include any simple attributes of *R* as attributes of *S*



Step 4

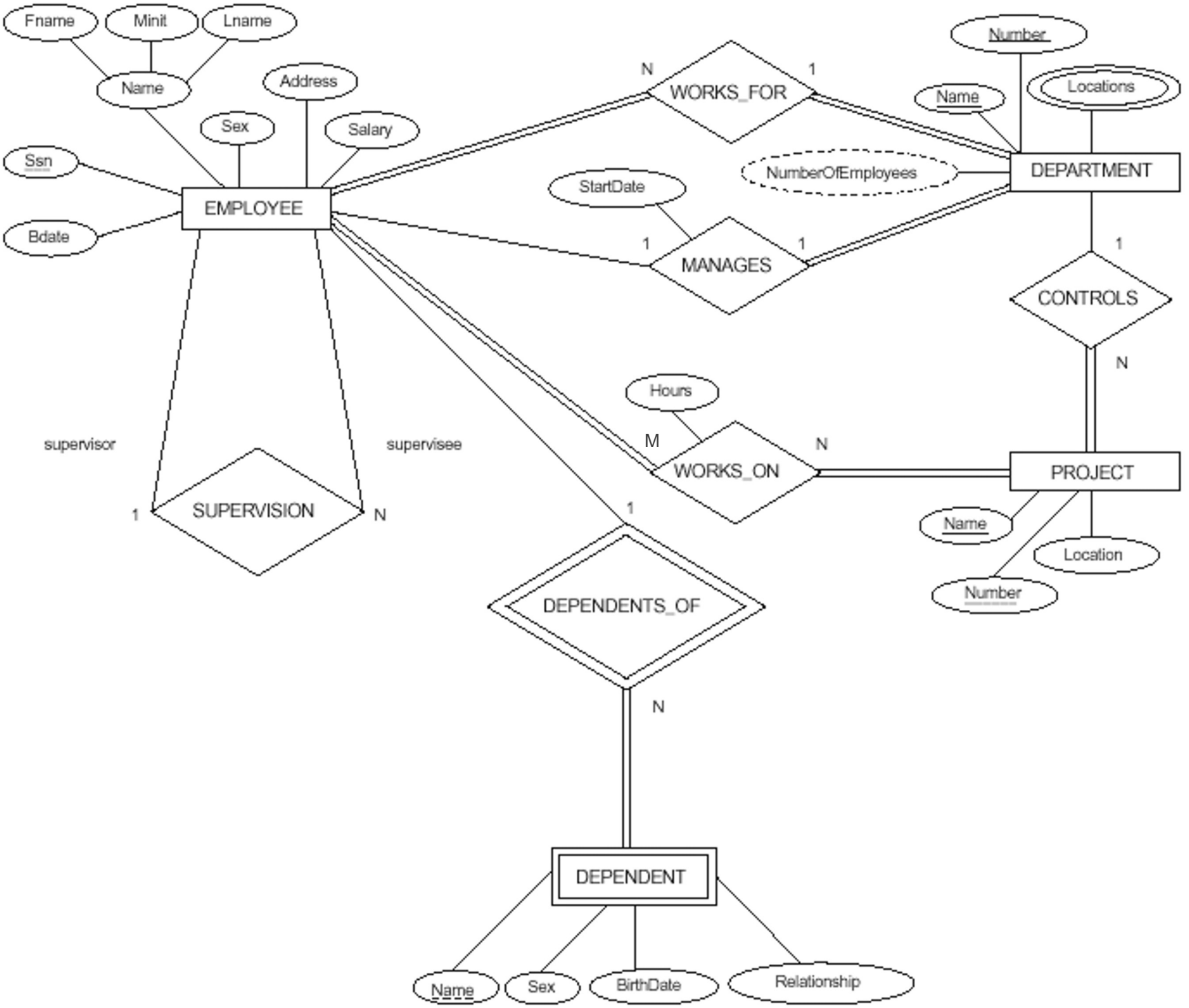


EMPLOYEE

Fname	Minit	Lname	Ssn	Bdate	Address	Sex	Salary	Super_ssn	Dno

DEPARTMENT

Dname	Dnumber	Mgr_ssn	Mgr_start_date


Fname
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Sex
Salary
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EMPLOYEE
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WORKS_FOR
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Number
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Locations
DEPARTMENT
NumberOfEmployees
StartDate
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MANAGES
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CONTROLS
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Hours
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WORKS_ON
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PROJECT
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Location
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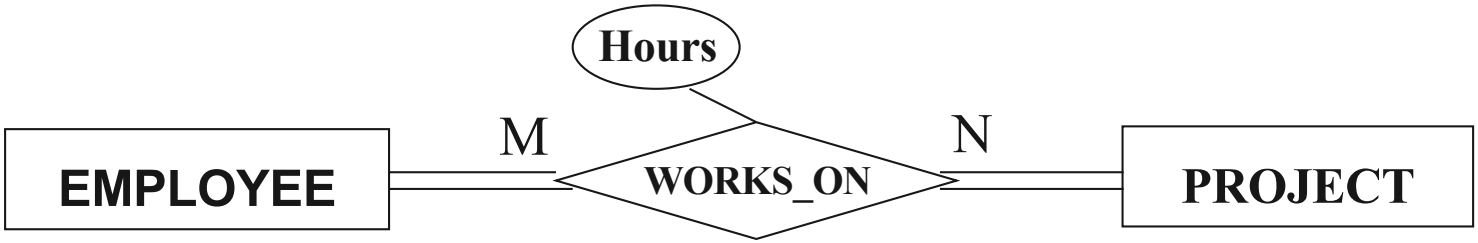
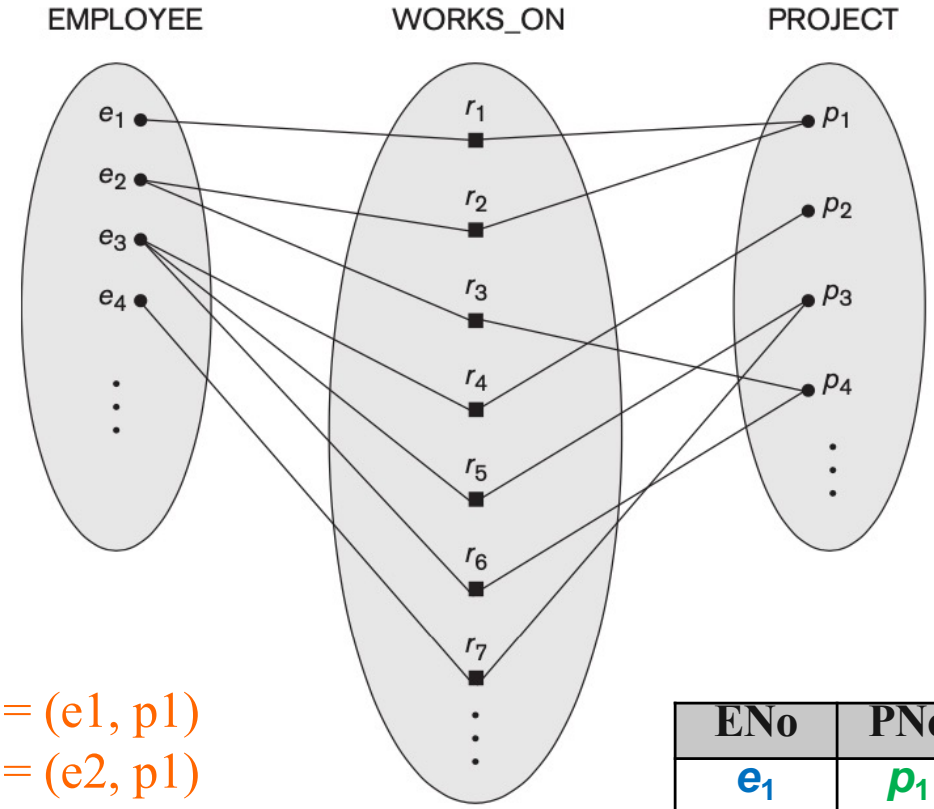
Name
Sex
BirthDate
Relationship



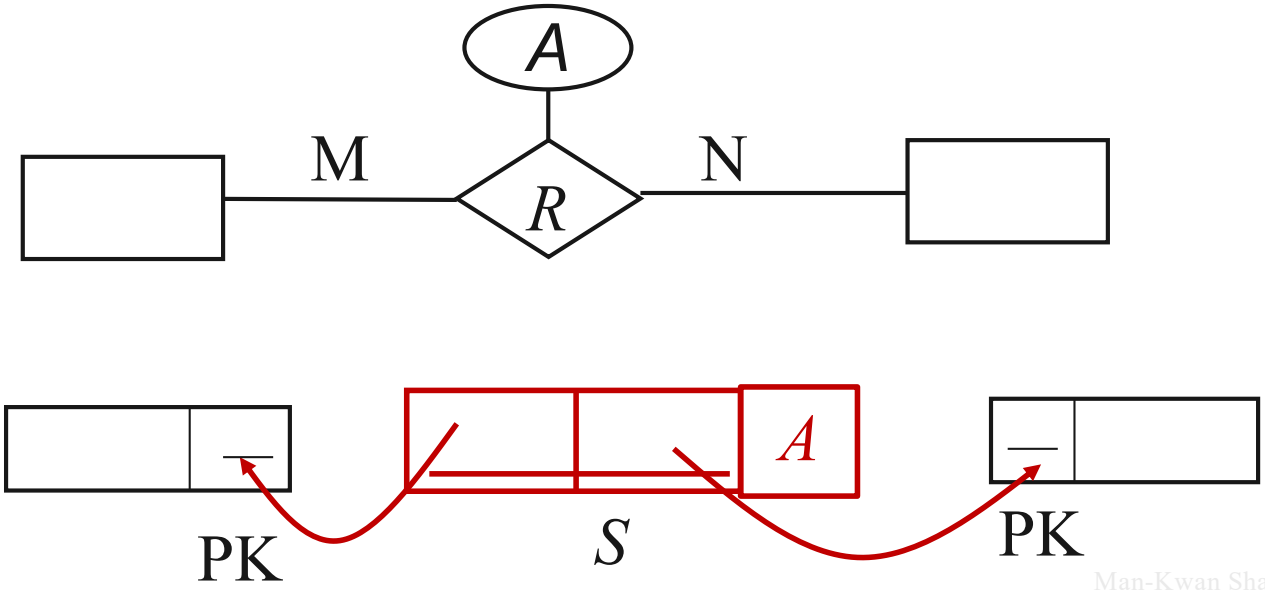


r1 = (e1, p1)
r2 = (e2, p1)
r3 = (e2, p4)
r4 = (e3, p2)
r5 = (e3, p3)
r6 = (e3, p4)
r7 = (e4, p3)

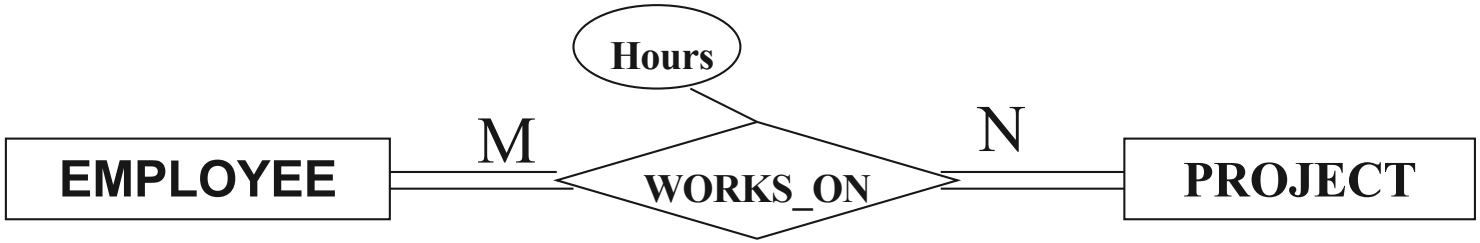
ENo	PNo
e_1	p_1
e_2	p_1
e_2	p_4
e_3	p_2
e_3	p_3
e_3	p_4
e_4	p_3

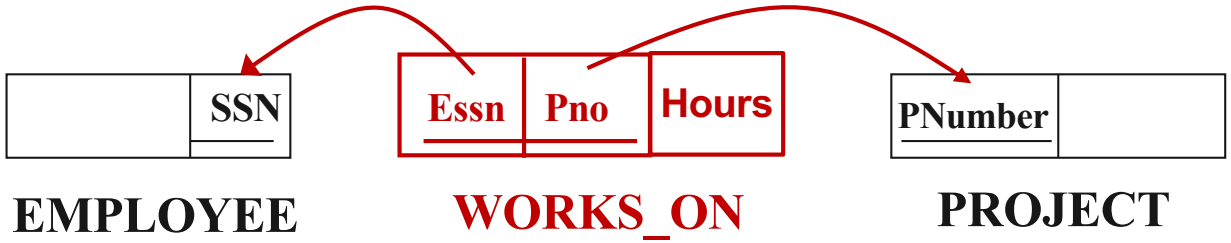
Step 5

- Step 5: for each binary M:N relationship type *R*
  - Create a new relation *S* to represent *R*
  - Include primary keys of participating relations as foreign key of *S*
  - Their combination form primary key of *S*
  - Include any simple attributes of *R* as attributes of *S*



Step 5





WORKS_ON

Essn	Pno	Hours

EMPLOYEE

Fname	Minit	Lname	Ssn	Bdate	Address	Sex	Salary	Super_ssn	Dno

PROJECT

Pname	Pnumber	Plocation	Dnum

ER-to-Relational Mapping Algorithm

Step 1: for each regular entity type E

Step 2: for each weak entity type W

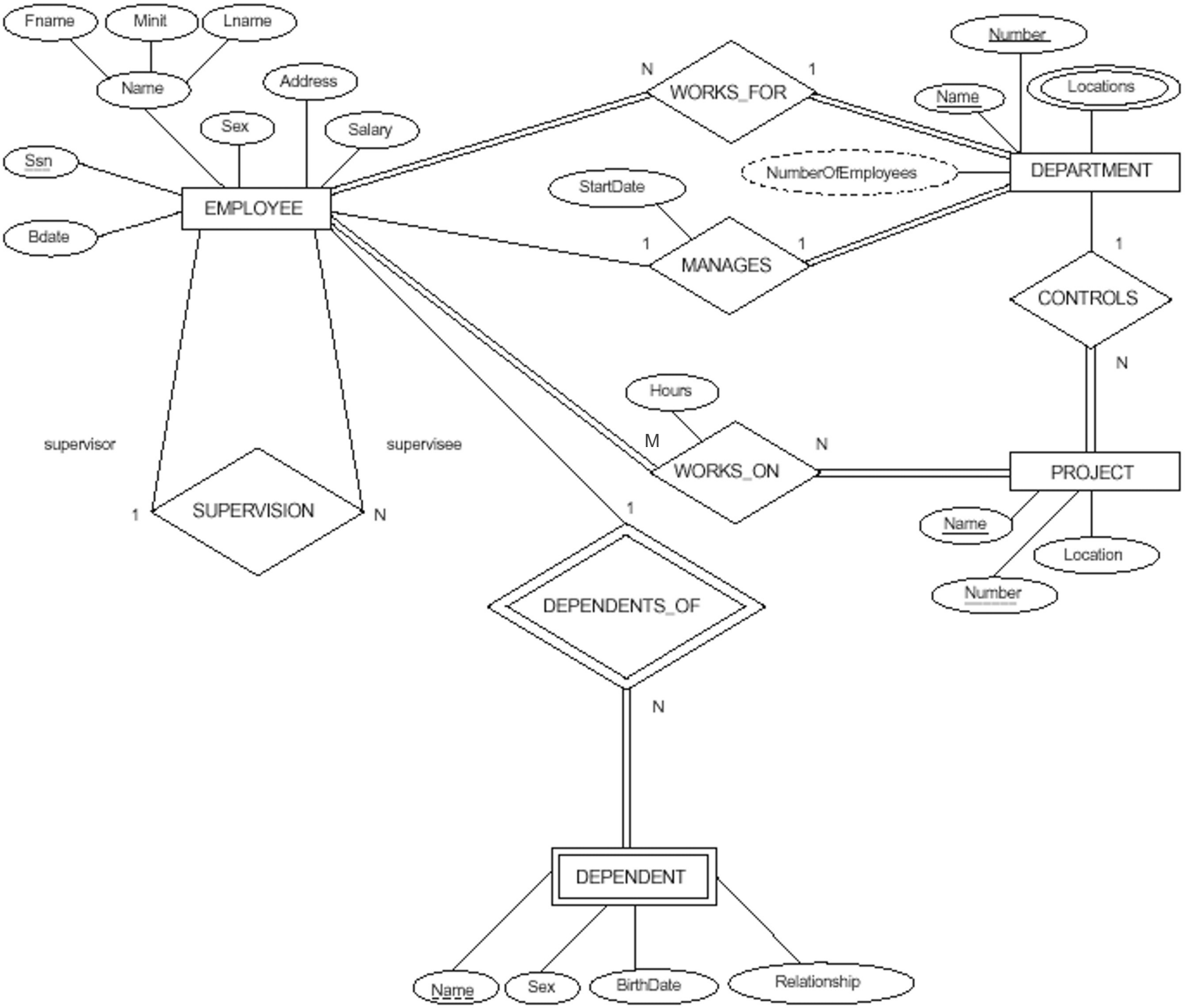
Step 3: for each binary 1:1 relationship type R

Step 4: for each binary 1:N relationship type R

Step 5: for each binary M:N relationship type R

Step 6: for each multivalued attribute A

Step 7: for each n-ary relationship type, n>2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EMPLOYEE
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Locations
DEPARTMENT
NumberOfEmployees
StartDate
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MANAGES
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CONTROLS
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Hours
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WORKS_ON
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PROJECT
Name
Location
Number
supervisor
supervisee
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SUPERVISION
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DEPENDENTS_OF
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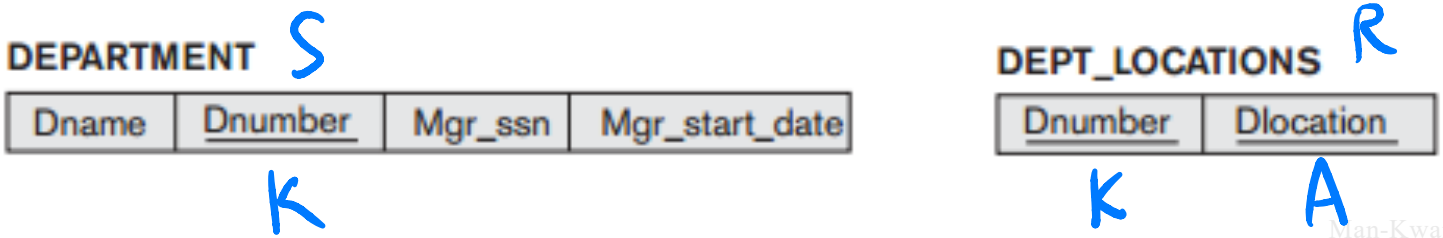
DEPENDENT
Name
Sex
BirthDate
Relationship

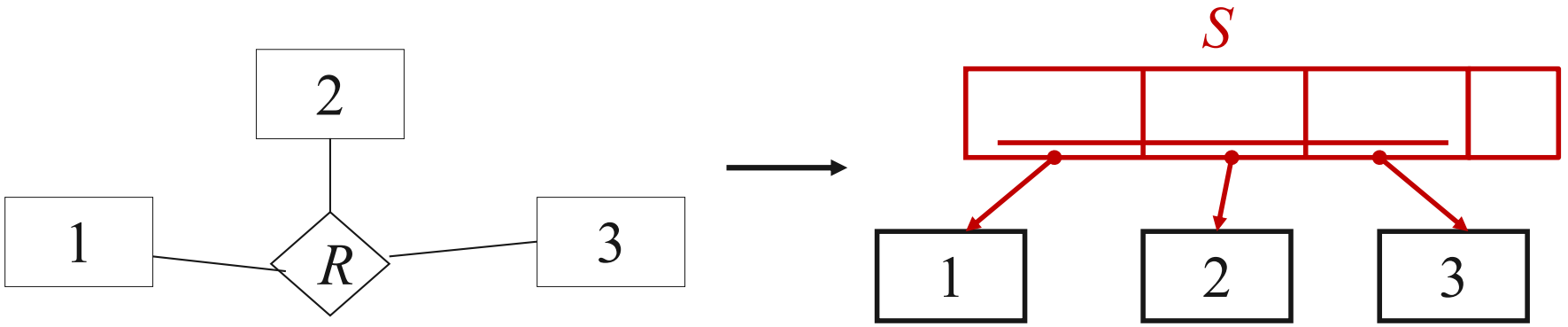
Step 6

- Step 6: for each multivalued attribute *A* of relation *S*
  - Create a new relation *R*
  - Include an attribute corresponding to *A*
  - Include primary key *K* (as a foreign key of *R*) of relation *S* as an attribute
  - Primary key of *R* = (*A*, *K*)
  - If *A* is composite, include its simple components



Step 7

- Step 7: for each *n*-ary relationship type *R*, where *n*>2
  - Create a new relation *S* to represent *R*
  - Include primary key of participating relations as foreign key
  - Include any simple attributes of *R* as attributes of *S*
  - Primary key of *S* = all foreign keys that references participating *R*



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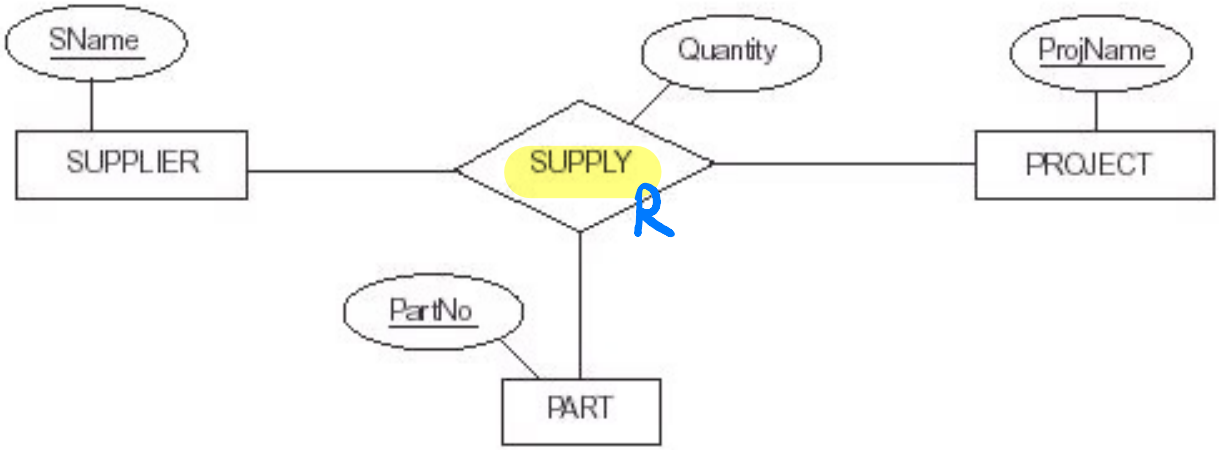


SUPPLIER

SNAME	• • •

PROJECT

PROJNAME	• • •

PART

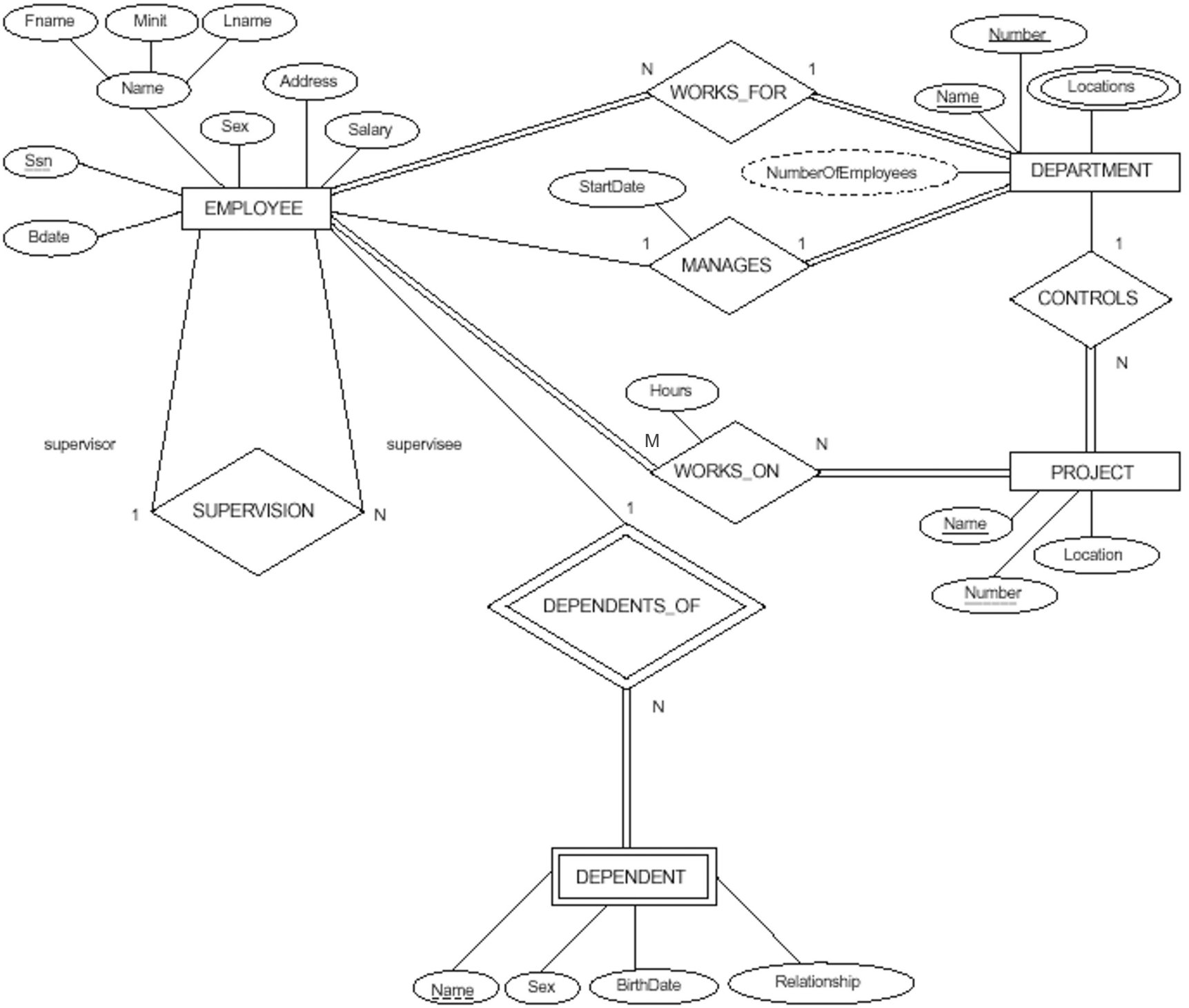
PARTNO	• • •

SUPPLY S

SNAME	PROJNAME	PARTNO	QUANTITY

Conclusions

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 & 2 foreign keys
N-ary relationship type	Relationship relation & n foreign keys
Simple attribute	Attribute
Composite attribute	Set of simple component attributes
Multivalued attribute	Relation & foreign key
Value set	Domain
Key attribute	Primary (or secondary) key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Locations
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NumberOfEmployees
StartDate
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PROJECT
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Location
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supervisor
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SUPERVISION
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DEPENDENTS_OF
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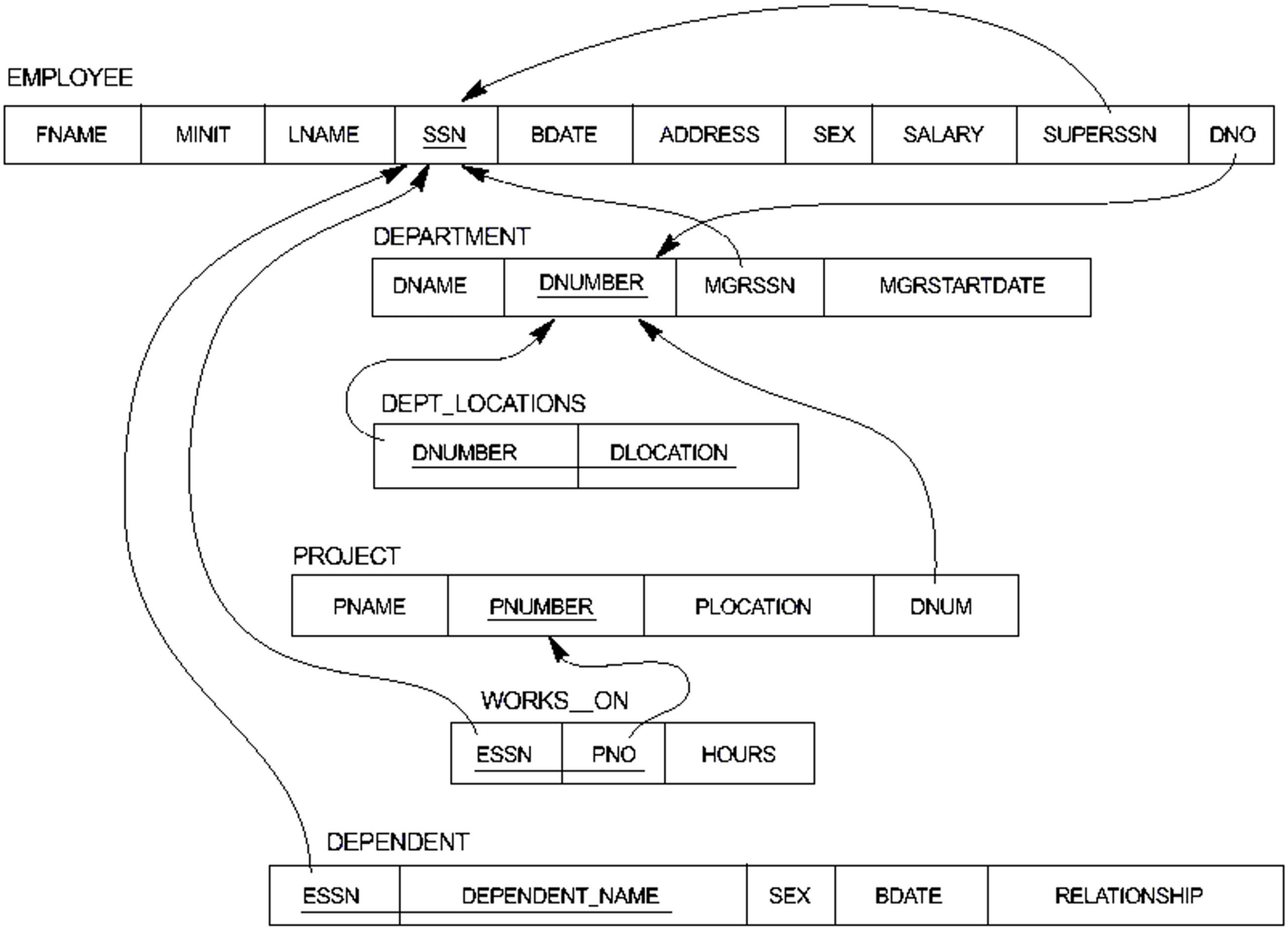
DEPENDENT
Name
Sex
BirthDate
Relationship


EMPLOYEE
FNAME
MINIT
LNAME
SSN
BDATE
ADDRESS
SEX
SALARY
SUPERSSN
DNO
DEPARTMENT
DNAME
DNUMBER
MGRSSN
MGRSTARTDATE
DEPT_LOCATIONS
DNUMBER
DLOCATION
PROJECT
PNAME
PNUMBER
PLOCATION
DNUM
WORKS_ON
ESSN
PNO
HOURS
DEPENDENT
ESSN
DEPENDENT_NAME
SEX
BDATE
RELATIONSHIP

Summary
ER-to-Relational Mapping Algorithm

Step 1: for each regular entity type E

Step 2: for each weak entity type W

Step 3: for each binary 1:1 relationship type R

Step 4: for each binary 1:N relationship type R

Step 5: for each binary M:N relationship type R

Step 6: for each multivalued attribute A

Step 7: for each n-ary relationship type, n>2