Week 10, Lecture 19, 20

Database Systems -

Introduction to Databases and Data Warehouses

CHAPTER 3 - Relational Database Modeling Part 3

MAIN TOPICS

- Map Unary Relationships (1:1, 1:M, M:N)
- Map Multiple Relationships Between Same Entities
- Map Weak Entities
- Example 2: Map ERD to Relational Schema

MAPPING UNARY RELATIONSHIPS

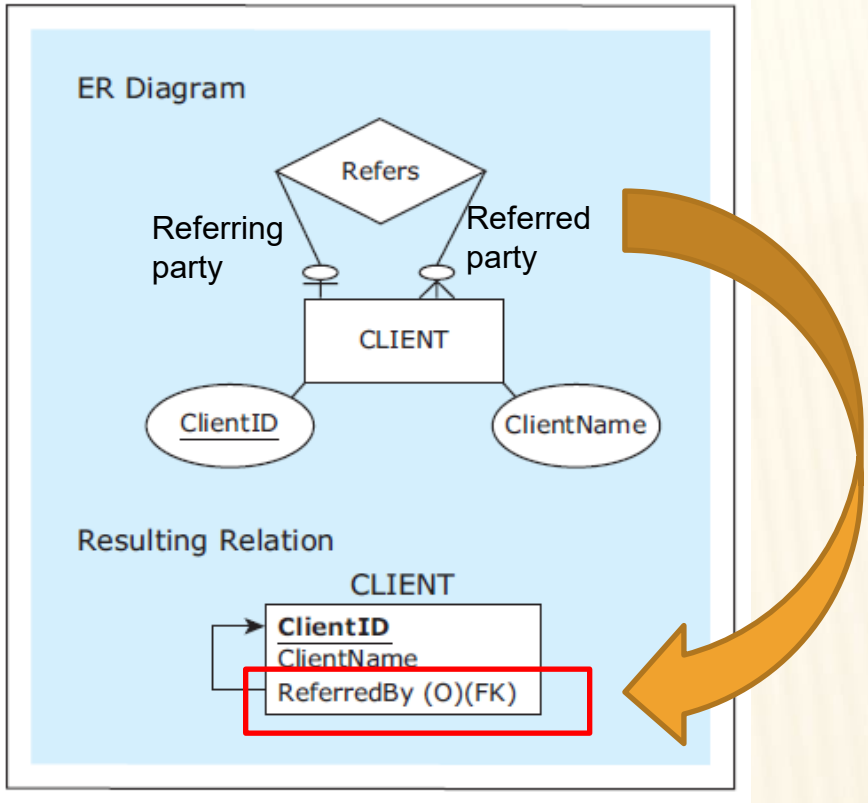
- **Mapping unary relationships**
  - In the same way as mapping binary relationships
    - Map **binary** relationships
      - M:N -- Add a new relation with composite primary key
      - 1:M -- Add a foreign key column to relation from entity on M side
      - 1:1 -- Add a foreign key column to chosen relation from one involved entity
        - Favor mandatory over optional

MAPPING UNARY RELATIONSHIPS

- Mapping 1:M unary relationships
  - The relation mapped from an entity involved in a 1:M unary relationship contains a foreign key that corresponds to its own primary key

MAPPING UNARY RELATIONSHIPS

Mapping a 1:M unary relationship



Sample data records for the mapped relation

CLIENT

ClientID	ClientName	ReferredBy
C111	Mark	
C222	Mike	C111
C333	Lilly	C111
C444	Jane	C222

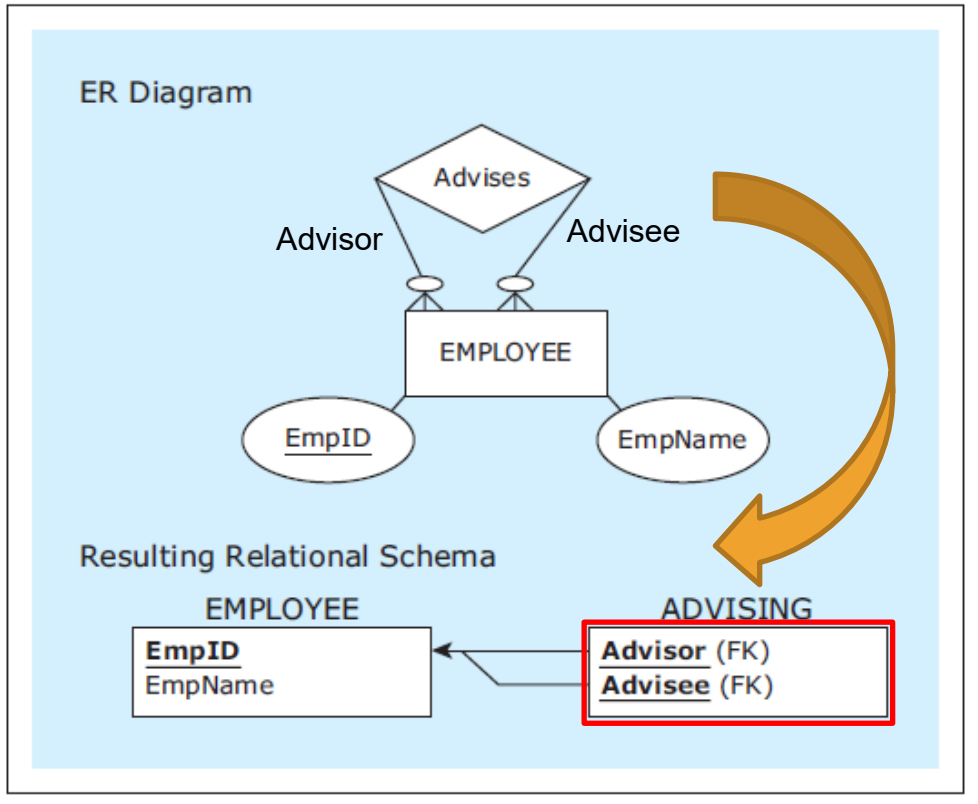
MAPPING UNARY RELATIONSHIPS

- Mapping M:N unary relationships
  - In addition to the relation representing the entity involved in a unary M:N relationship, another relation is created to **represent the M:N relationship itself**
    - Add a new relation for the M:N unary relationship
  - This new relation has **two foreign keys**, both of them corresponding to the primary key of the relation representing the entity involved in the unary M:N relationship
    - Add two foreign key columns to the new relation
  - Each of the **foreign keys is used as a part of the composite primary key** of the new relation
    - Two foreign keys together = composite primary key of the new relation

MAPPING UNARY RELATIONSHIPS

Mapping a M:N unary relationship

- Optional participation



Sample data records for the mapped relations

EMPLOYEE

EmpID	EmpName
1234	Becky
2345	Molly
3456	Rob
1324	Ted

ADVISING

Advisor	Advisee
1234	2345
1234	3456
2345	1324
3456	1324
1234	1324

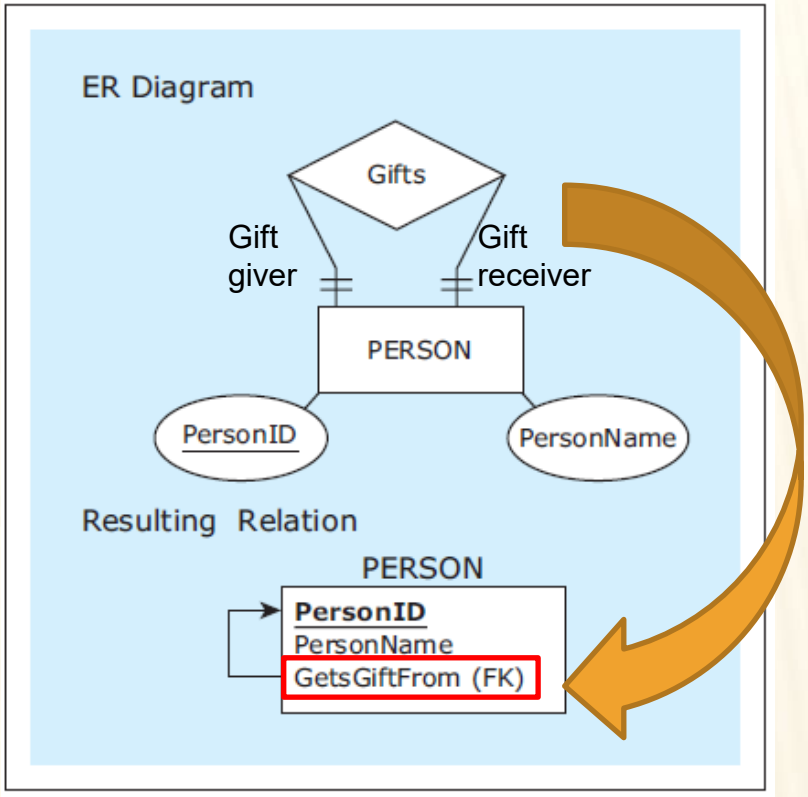
MAPPING UNARY RELATIONSHIPS

- Mapping 1:1 unary relationships
  - Mapped in the same way as 1:M binary relationships
    - Add a foreign key column in the relation for entity, referring to the primary key of the relation

MAPPING UNARY RELATIONSHIPS

Mapping a 1:1 unary relationship

- Mandatory participation



Sample data records for the mapped relation

PERSON

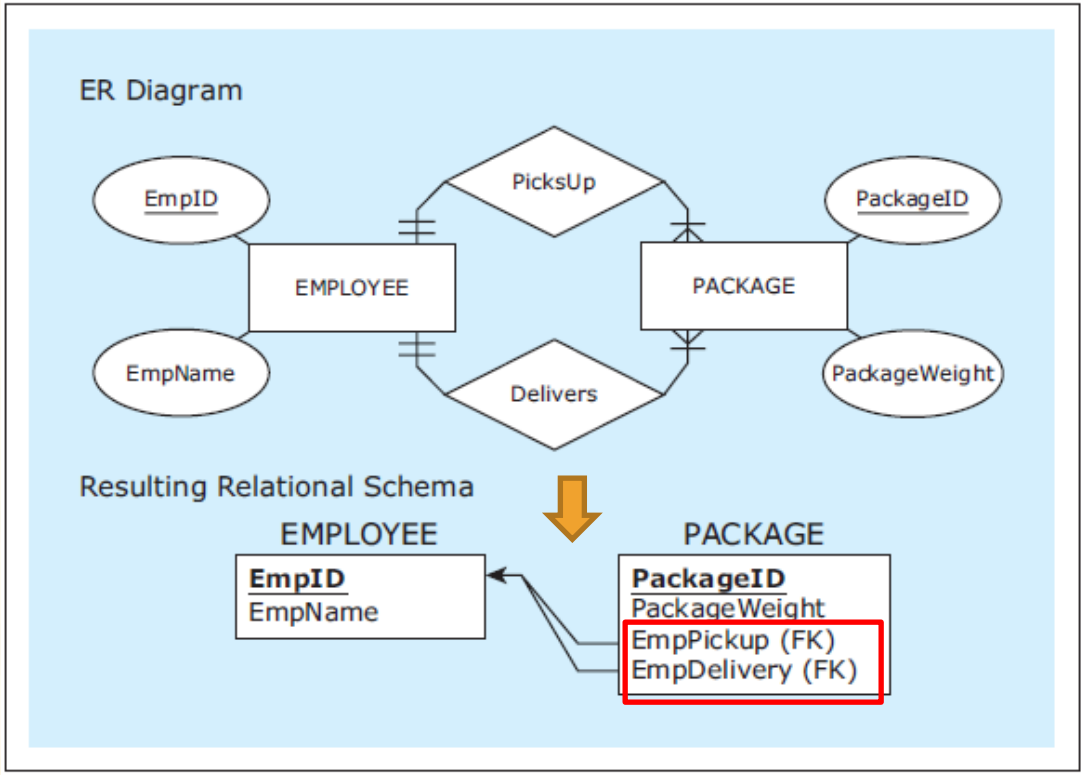
PersonID	PersonName	GetsGiftFrom
P111	Rose	P333
P222	Violet	P111
P333	James	P444
P444	Lena	P222

MAPPING MULTIPLE RELATIONSHIPS BETWEEN THE SAME ENTITIES

- Mapping multiple relationships between the same entities
  - Each relationship is mapped

MAPPING MULTIPLE RELATIONSHIPS BETWEEN THE SAME ENTITIES

Mapping multiple relationships between the same entities



Sample data records for the mapped relations

EMPLOYEE

EmpID	EmpName
1234	Becky
2345	Molly
3456	Rob
1324	Ted

PACKAGE

PackageID	PackageWeight	EmpPickup	EmpDelivery
P111	5	1234	2345
P222	12	1234	1324
P333	3	2345	1234
P444	10	3456	1234
P555	7	1324	3456

MAPPING WEAK ENTITIES

- Mapping weak entities
  - Map weak entities in the same way as regular entities with one addition:
    - If weak entity has a partial key, add to the resulting relation a composite primary key that is composed of:
      - The partial key and
      - The foreign key corresponding to the primary key of the owner entity
        - If more than one owner entity, add one foreign key for each owner entity

MAPPING WEAK ENTITIES

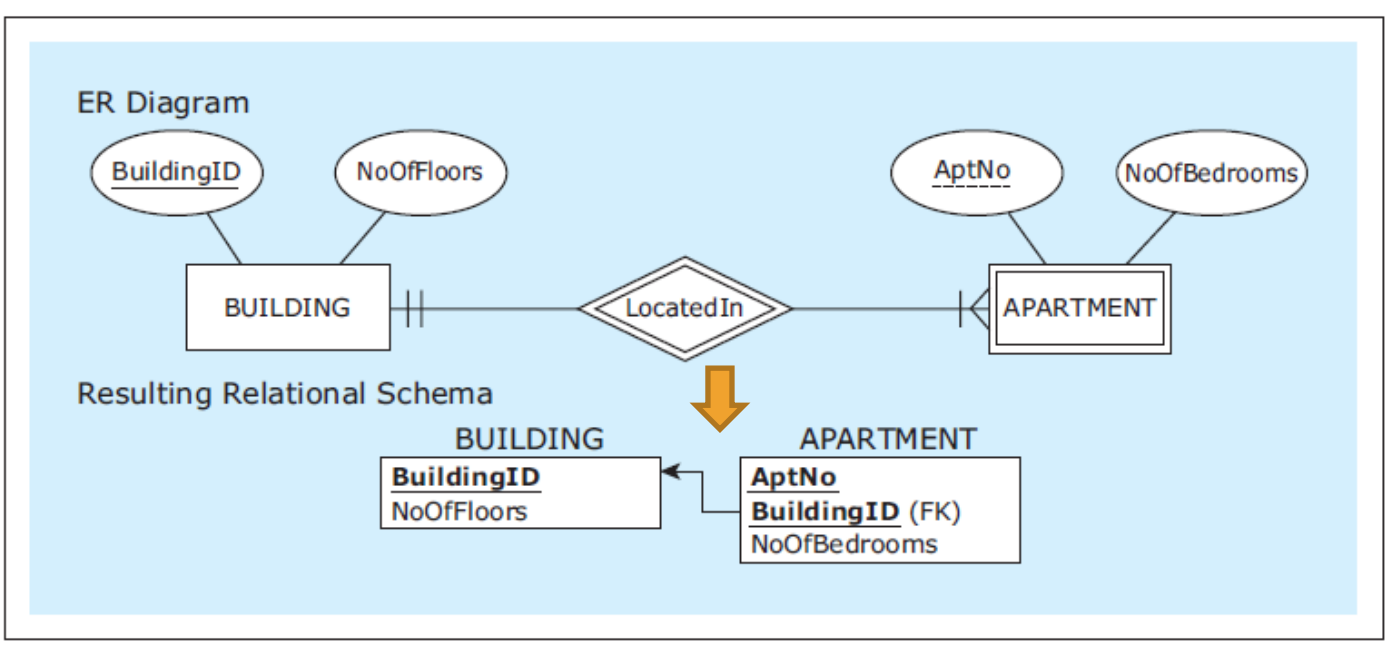
Mapping a weak entity with partial key

- Composite primary key in APARTMENT relation

(partial key, foreign key)

- Relationship LocatedIn already mapped when mapping APARTMENT

Sample data records for the mapped relations



BUILDING

BuildingID	NoOfFloors
A	3
B	2
C	2

APARTMENT

BuildingID	AptNo	NoOfBedrooms
A	101	4
A	201	4
A	301	5
B	101	2
B	201	2
C	101	3
C	102	3
C	201	4

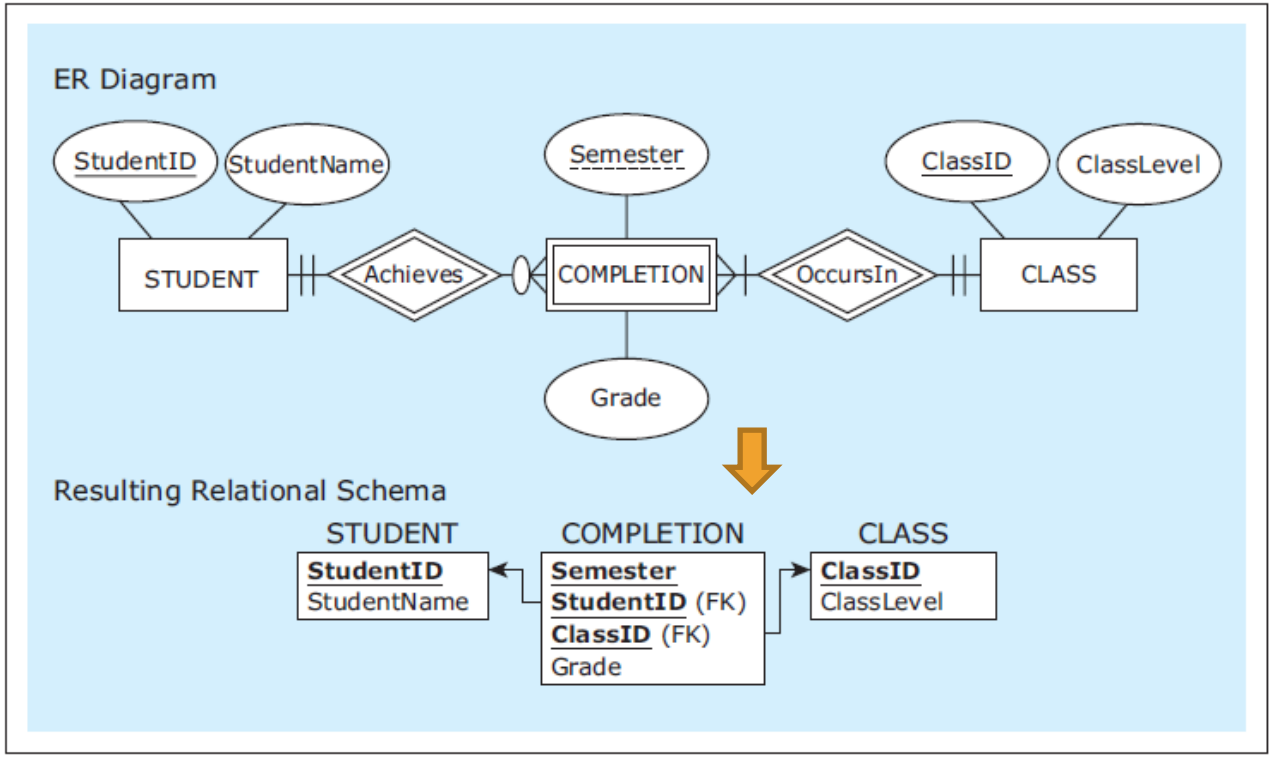
MAPPING WEAK ENTITIES

Mapping a weak entity with partial key and two owners

- Composite primary key in COMPLETION relation

(partial key, foreign key1, foreign key2)

Sample data records for the mapped relations



STUDENT

StudentID	StudentName
1111	Robin
2222	Pat
3333	Jami

CLASS

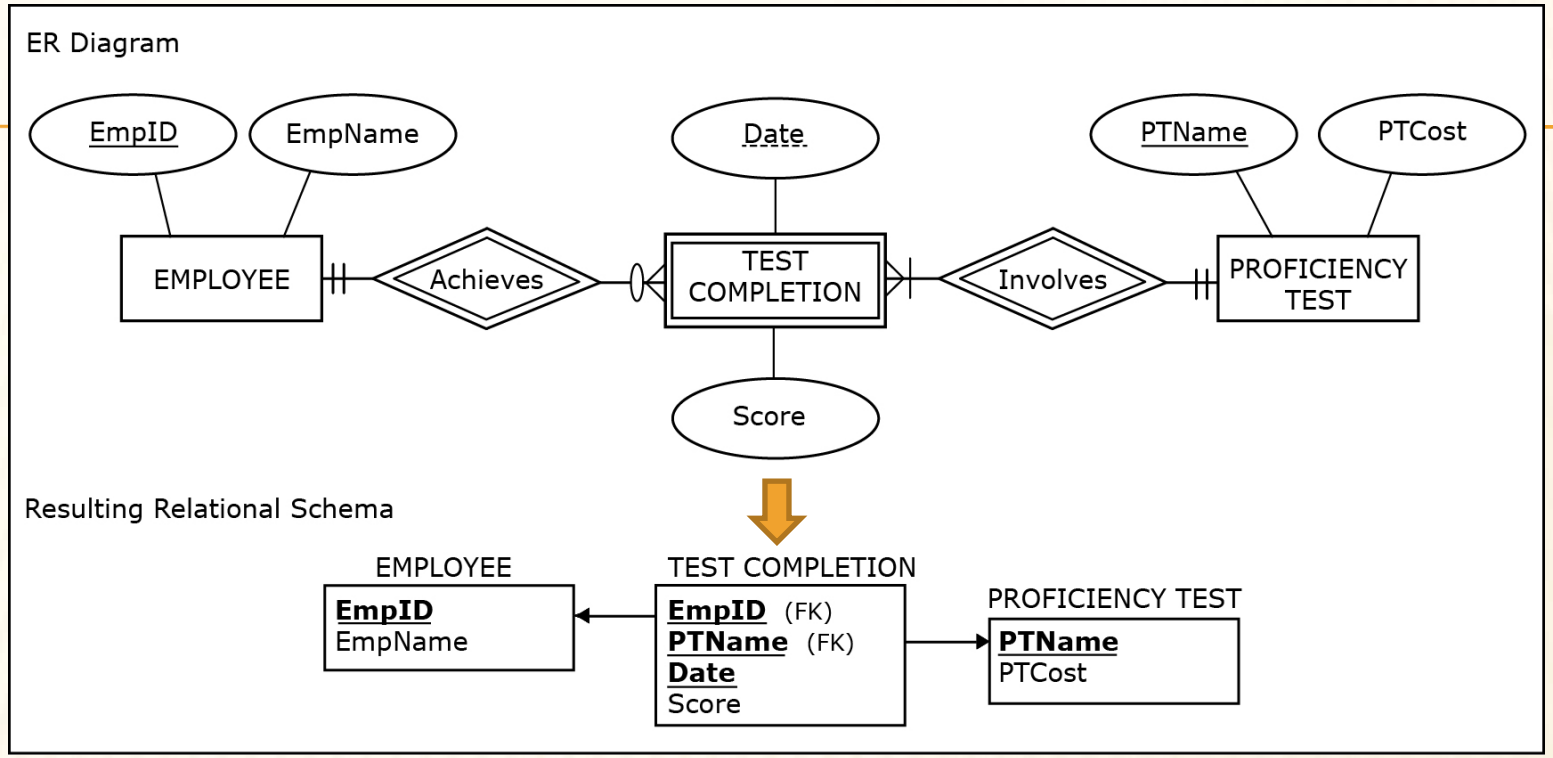
ClassID	ClassLevel
IS101	Freshman
IS241	Sophomore
IS247	Sophomore

COMPLETION

StudentID	ClassID	Semester	Grade
1111	IS101	Spring10	D
1111	IS101	Spring11	D
1111	IS101	Spring12	A
1111	IS241	Fall12	B
2222	IS101	Fall12	A
2222	IS241	Fall12	C
2222	IS247	Spring13	B
3333	IS101	Fall12	A

MAPPING WEAK ENTITIES

Mapping a weak entity with two owners



Sample data records for the mapped relations

EMPLOYEE

EmpID	EmpName
1111	Amelia
2222	Max
3333	Erin

PROFICIENCY TEST

PTName	PTCost
Conflict Mediation	$100.00
Regulatory Compliance	$200.00
Risk Management	$150.00

COMPLETION

EmpID	PTName	Date	Score
1111	Conflict Mediation	2.2.2020	85
2222	Conflict Mediation	2.2.2020	45
2222	Conflict Mediation	3.3.2020	45
2222	Conflict Mediation	4.4.2020	90
2222	Risk Management	4.8.2020	80
3333	Risk Management	2.2.2020	95
3333	Regulatory Compliance	3.3.2020	90

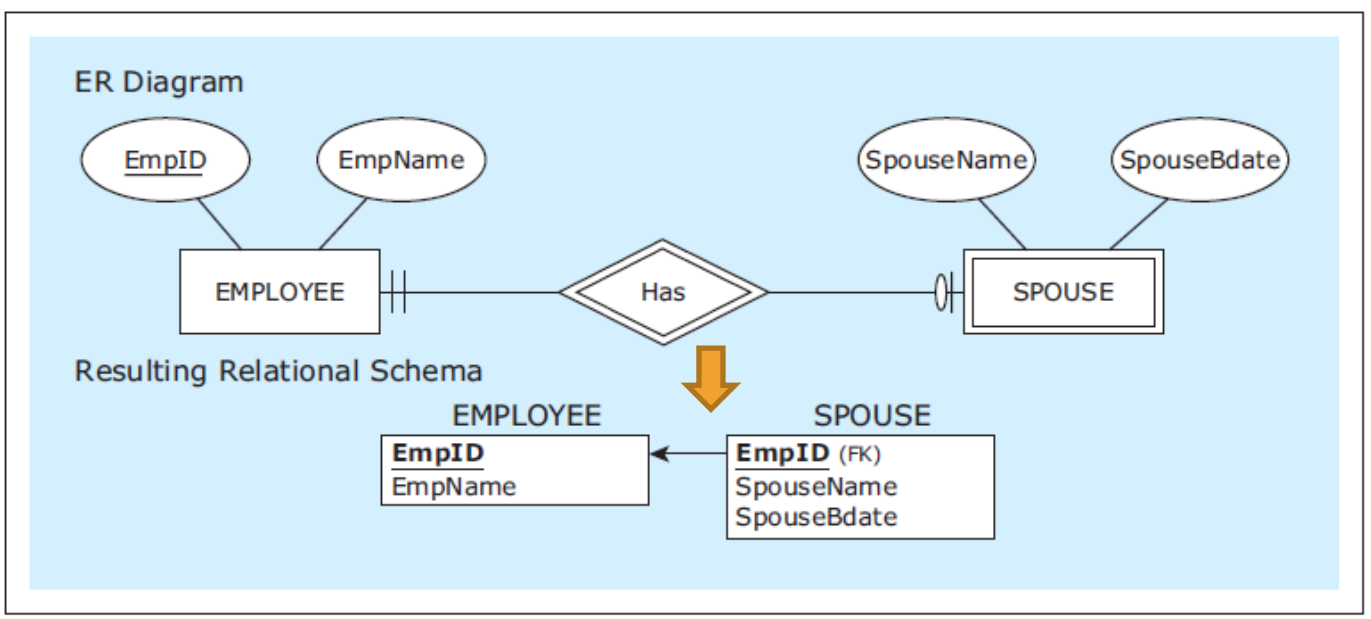
MAPPING WEAK ENTITIES

- **Mapping weak entities (continue)**
  - Map weak entities in the same way as regular entities with one addition:
    - **If no partial key** in weak entity (often 1:1 identifying relationship)
      - Add to the resulting relation a **foreign key** corresponding to the primary key of the owner entity
      - The **foreign key** is **also the primary key** of the resulting relationship

MAPPING WEAK ENTITIES

Mapping a weak entity with no partial key

- Primary key and foreign key in SPOUSE relation (EmpID)



Sample data records for the mapped relations

EMPLOYEE

EmpID	EmpName
1234	Becky
2345	Molly
3456	Rob
1324	Ted

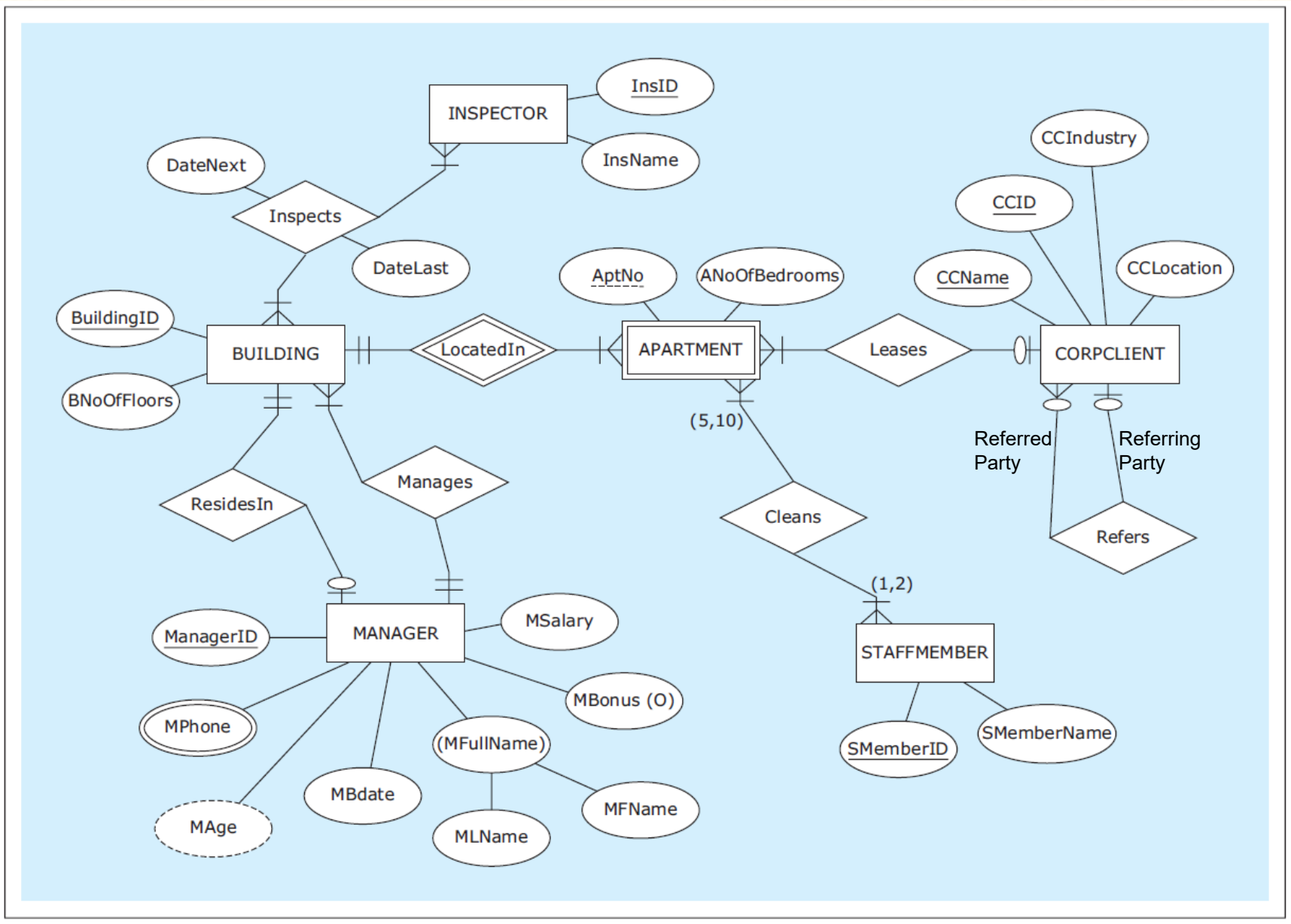
SPOUSE

EmpID	SpouseName	SpouseBdate
1234	Steve	Jan 18
3456	Luchy	Jun 21
1324	Tina	Feb 11

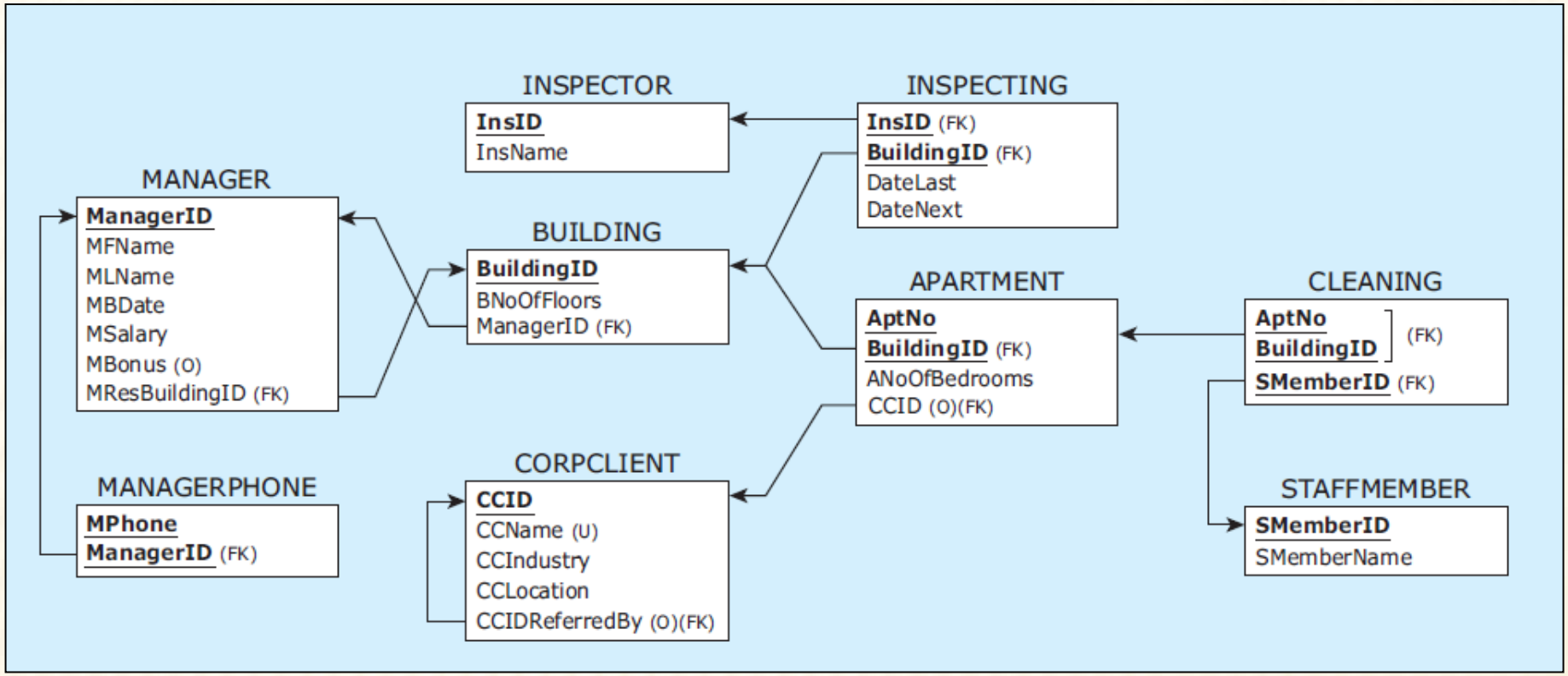
MAPPING ER DIAGRAM INTO RELATIONAL SCHEMA

- **Mapping an ER diagram into a relational schema (more)**
  1. Map all entities and their attributes
     - From left to right & from top to down (**can map weak entities last if desired**)
     - **Special-Mapping of multivalued attributes and weak entities**
  2. Map all relationships
     - From left to right & from top to down
     - Steps to map each relationship
       1) Identify the type: 1:1, 1:M, or M:N
       2) Map the relationship according to its type
          - M:N, add a new relation with composite PK
          - 1:M, add a FK to relation from entity on M side
          - 1:1, decide which relation to add FK, then add FK
          - **May need to rename FK columns in unary relationships**
     - **No additional mapping of identifying relationships**
       - **Already done during mapping weak entities**
  3. Verify the resulting relational schema
     - Compare the relational schema to the ER diagram

Example ER diagram : HAFH Realty Company Property Management Database



Example mapped relational schema: HAFH Realty Company Property Management Database



Example: Sample data records for the HAFH Realty Company Property Management Database (part 1)

INSPECTOR

InsID	InsName
I11	Jane
I22	Niko
I33	Mick

BUILDING

BuildingID	BNoOfFloors	BManagerID
B1	5	M12
B2	6	M23
B3	4	M23
B4	4	M34

APARTMENT

BuildingID	AptNo	ANoOfBedrooms	CCID
B1	41	1	
B1	21	1	C111
B2	11	2	C222
B2	31	2	
B3	11	2	C777
B4	11	2	C777

INSPECTING

InsID	BuildingID	DateLast	DateNext
I11	B1	15-MAY-2012	14-MAY-2013
I11	B2	17-FEB-2013	17-MAY-2013
I22	B2	17-FEB-2013	17-MAY-2013
I22	B3	11-JAN-2013	11-JAN-2014
I33	B3	12-JAN-2013	12-JAN-2014
I33	B4	11-JAN-2013	11-JAN-2014

Requirements in ERD: Participation, Exact Cardinality
Requirements in Relational Schema: Primary Key, Foreign Key,

Example: Sample data records for the HAFH Realty Company Property Management Database (part 2)

MANAGER

ManagerID	MFName	MLName	MBDate	MSalary	MBonus	MResBuildingID
M12	Boris	Grant	20-JUN-1980	60000		B1
M23	Austin	Lee	30-OCT-1975	50000	5000	B2
M34	George	Sherman	11-JAN-1976	52000	2000	B4

CLEANING

BuildingID	AptNo	SMemberID
B1	21	5432
B1	41	9876
B2	11	9876
B2	31	5432
B3	11	5432
B4	11	7652

MANAGERPHONE

ManagerID	MPhone
M12	555-2222
M12	555-3232
M23	555-9988
M34	555-9999

STAFFMEMBER

SMemberID	SMemberName
5432	Brian
9876	Boris
7652	Caroline

CORPCLIENT

CCID	CCName	CCIndustry	CCLocation	CCIDReferredBy
C111	BlingNotes	Music	Chicago	
C222	SkyJet	Airline	Oak Park	C111
C777	WindyCT	Music	Chicago	C222
C888	SouthAlps	Sports	Rosemont	C777