Spring 2019
Week 12, Lecture 23

Database Systems -

Introduction to Databases and Data Warehouses

CHAPTER 3 - Relational Database Modeling Part 3

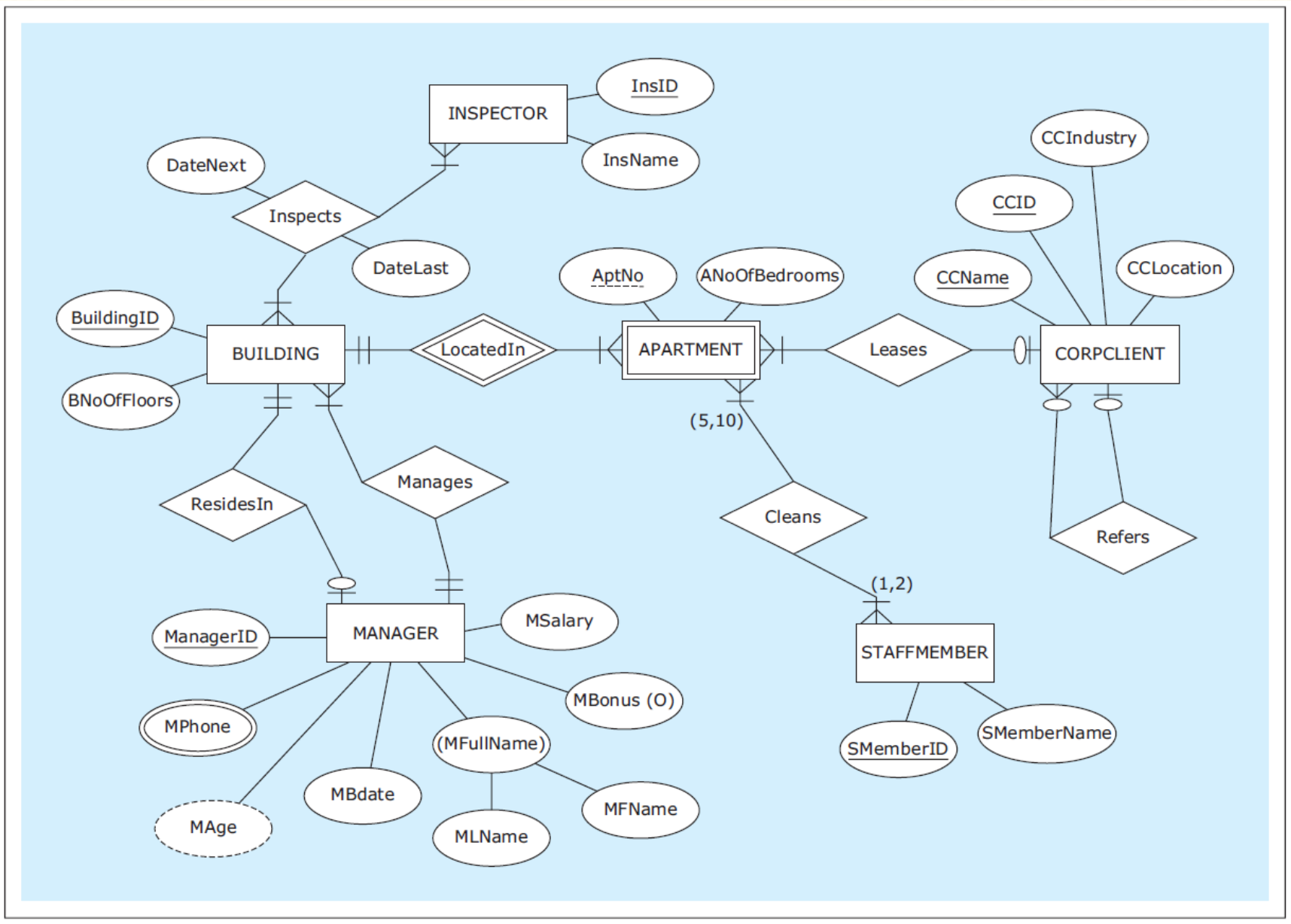
MAIN TOPICS

- Example 2: Map ERD to Relational Schema
- Relational Database Constraints
  - Implicit, User-Defined

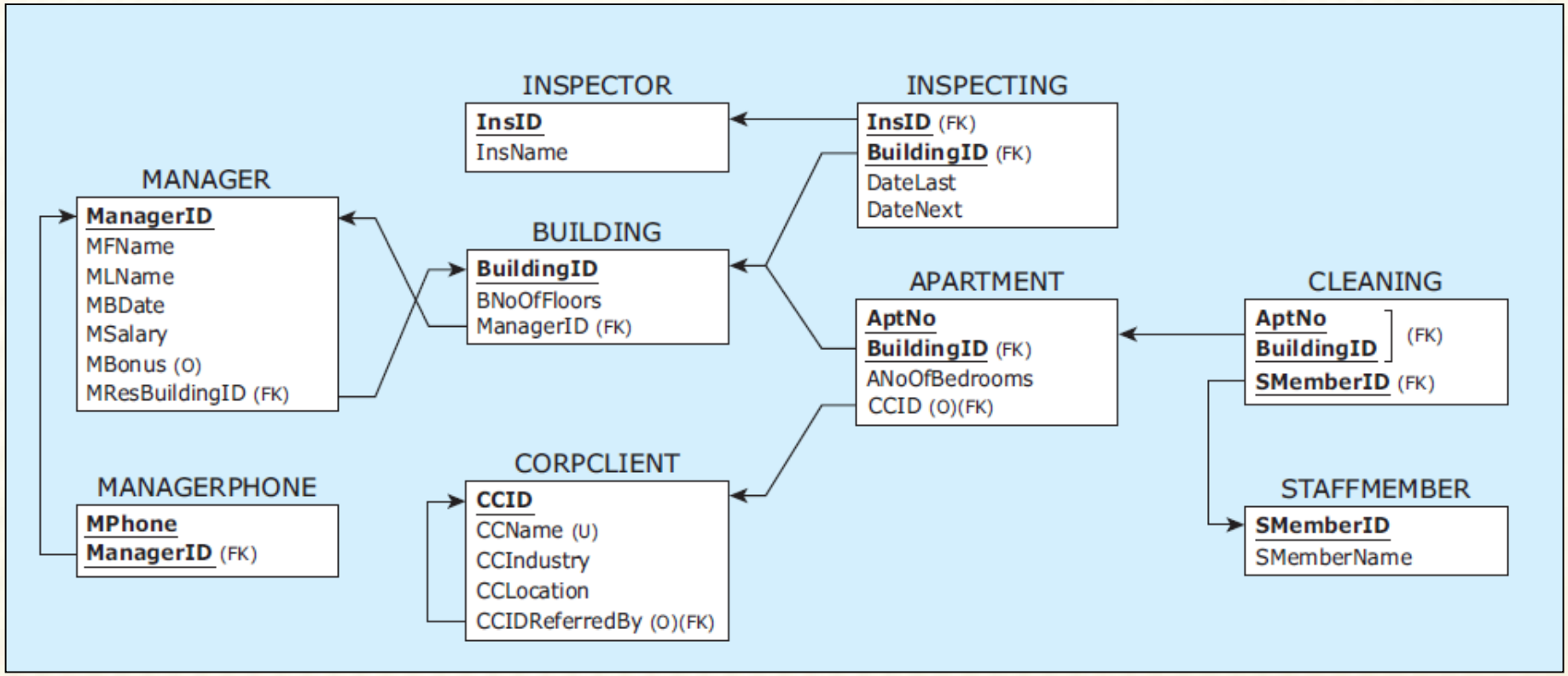
MAPPING ER DIAGRAM INTO RELATIONAL SCHEMA

- **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; unary or binary
       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
PK, FK, Participation, Exact Cardinality

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

RELATIONAL DATABASE CONSTRAINTS

- **Relational database constraints**
  - Rules that a relational database has to satisfy in order to be valid
  - 2 Categories
    - **Implicit constraints**
      - The implicit relational database model rules that a relational database must satisfy in order to be valid
    - **User-defined constraints**
      - Database constraints that are added by the database designer

RELATIONAL DATABASE CONSTRAINTS

- **Implicit constraints**
  - Unique relation names in a relational schema
  - Required conditions for each relation:
    - Unique column name
    - Unique row
    - In each row, each value in each column must be **single valued**
    - **Domain constraint**
      - All values in each column must be from the same predefined domain
    - Irrelevant order of columns
    - Irrelevant order of rows

RELATIONAL DATABASE CONSTRAINTS

- Implicit constraints (cont'd)
  - Primary key constraint
    - Each relation must have a primary key (non-composite or composite)
  - Entity integrity constraint
    - No primary key column can have null values
  - Foreign key constraint
    - Foreign key column in a relation refers to primary key column in another relation (i.e referred relation)
  - Referential integrity constraint
    - The value of a foreign key in a relation must be
      - Either a matching value in the primary key column of the referred relation
      - Or null if optional

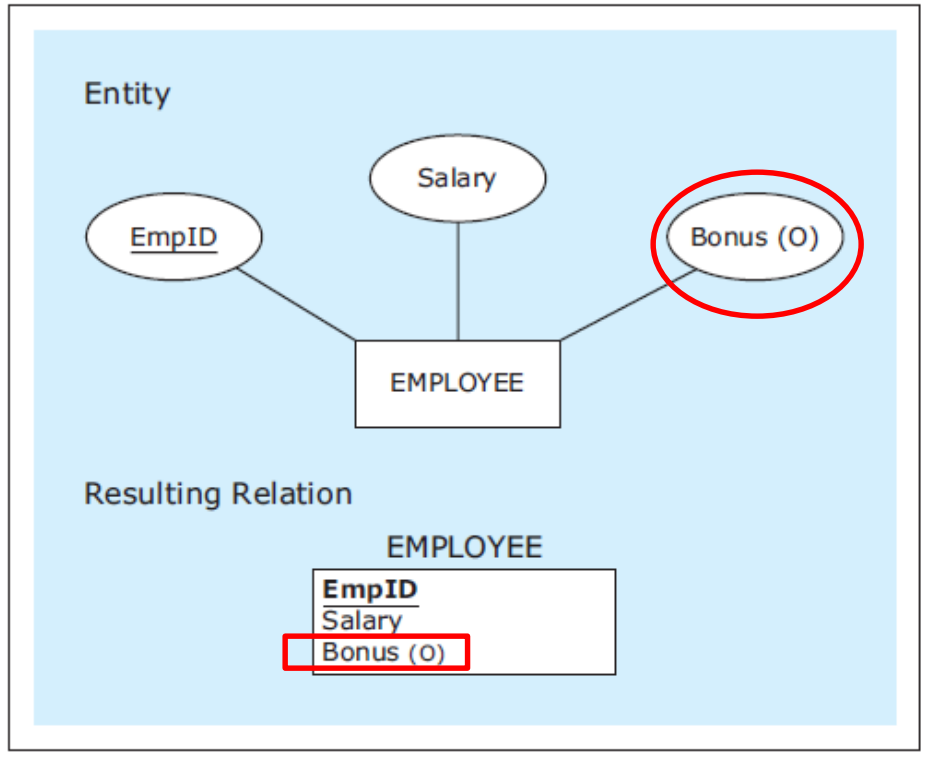
RELATIONAL DATABASE CONSTRAINTS

- User-defined constraints
  - Added by the database designers for the database being developed
  - User-defined constraints specified in ER diagram
    - Optional attribute in ER diagram
      - Figure 3.11, Figure 3.12, optional Bonus in EMPLOYEE
    - Mandatory foreign key in relational schema and mandatory participation in ER diagram
      - Figure 3.15, Figure 3.16, DeptID in EMPLOYEE relation
    - Mandatory referral of each primary key value and mandatory participation in ER diagram
      - Figure 3.15, Figure 3.16, DeptID in DEPARTMENT relation
    - Exact minimum and maximum cardinalities in ER diagram
      - Figure 3.61, Figure 3.62

RELATIONAL DATABASE CONSTRAINTS

Figure3.11

Entity with an optional attribute mapped into a relation



Optional attribute constraint

Figure3.12

Sample data records for the mapped relation

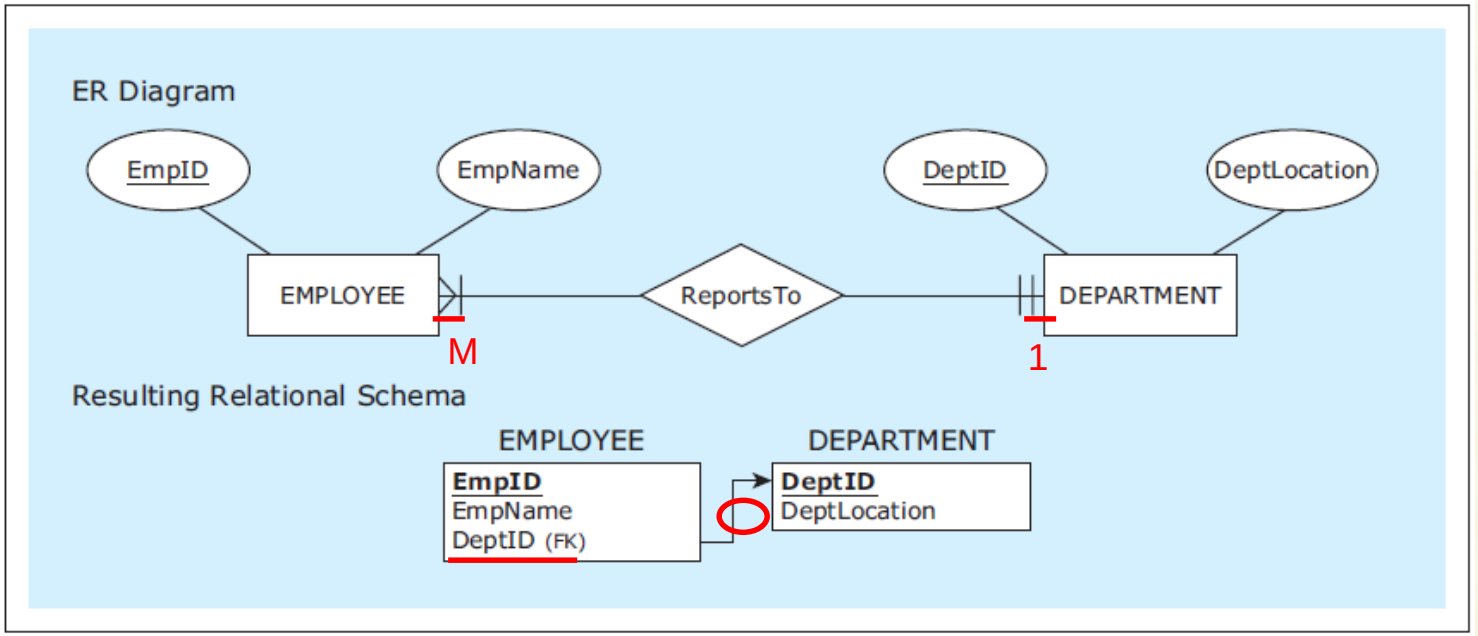
EMPLOYEE

EmpID	Salary	Bonus
1234	$75,000	
2345	$45,000	$10,000
3456	$55,000	$4,000
1324	$70,000	

RELATIONAL DATABASE CONSTRAINTS

Figure3.15

Example - Map 1:M relationship



Mandatory foreign key constraint

Figure3.16

Sample data records for the mapped ER diagram

EMPLOYEE

EmpID	EmpName	DeptID
1234	Becky	1
2345	Molly	2
3456	Rob	1
1324	Ted	2

DEPARTMENT

DeptID	DeptLocation
1	Suite A
2	Suite B

And Mandatory referral of each primary key value

RELATIONAL DATABASE CONSTRAINTS

Figure3.19

Example - Map a 1:M relationship

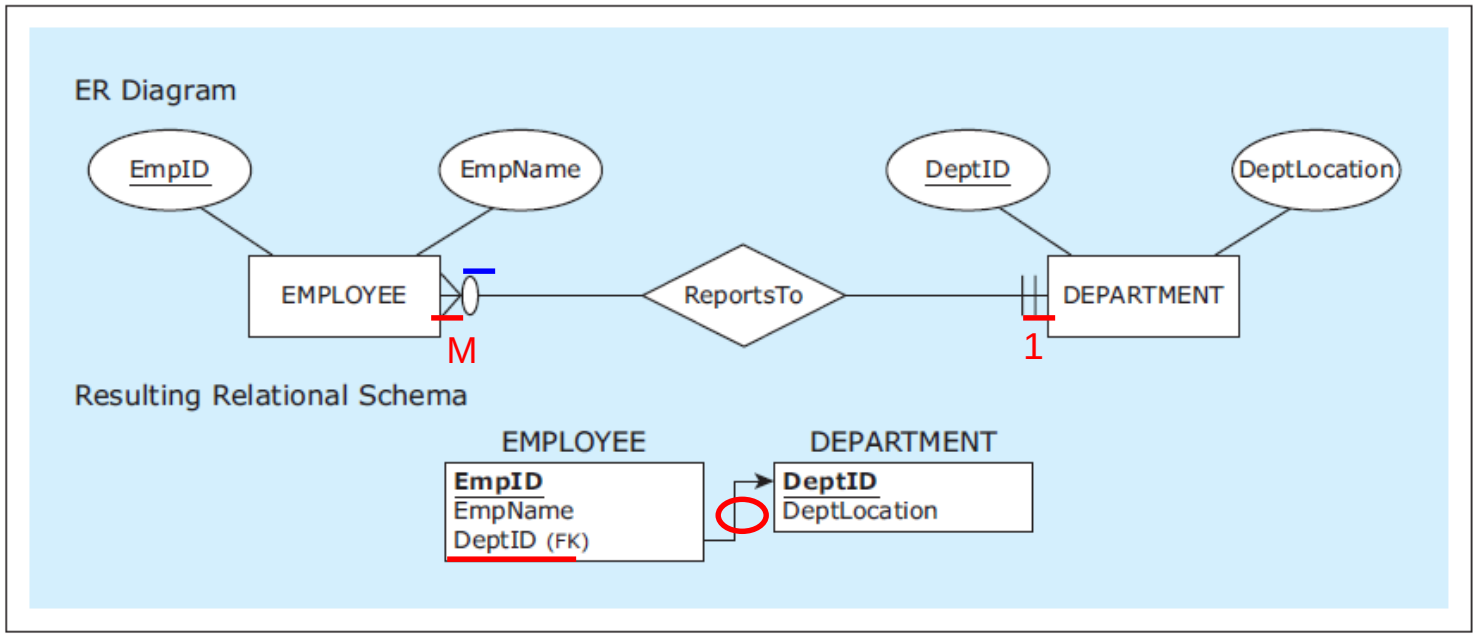


Figure3.20

Sample data records for the mapped ER diagram

EMPLOYEE

EmpID	EmpName	DeptID
1234	Becky	1
2345	Molly	2
3456	Rob	1
1324	Ted	2

DEPARTMENT

DeptID	DeptLocation
1	Suite A
2	Suite B
3	Suite C

NO mandatory referral of each primary key value

RELATIONAL DATABASE CONSTRAINTS

Figure3.61

Specific minimum and maximum cardinalities

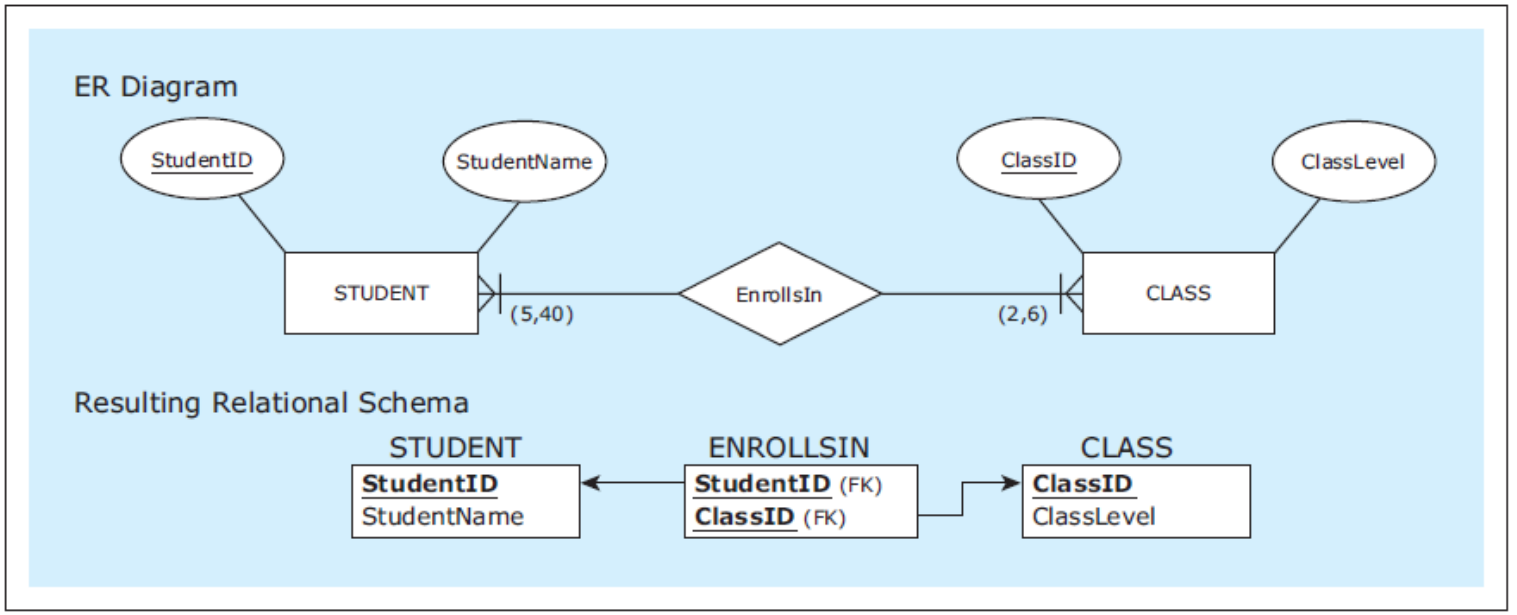


Figure3.62

Sample data records for the mapped relations

STUDENT

StudentID	SName
1111	Robin
2222	Pat
3333	Jami
4444	Zach
5555	Louie

CLASS

ClassID	ClassLevel
IS346	Junior
IS401	Senior

ENROLLSIN

StudentID	ClassID
1111	IS346
2222	IS346
3333	IS346
4444	IS346
5555	IS346
1111	IS401
2222	IS401
3333	IS401
4444	IS401
~~2222~~ 5555	IS401

Exact minimum and maximum cardinalities

Typo here.