Spring 2019
Week 12, Lecture 23

Database Systems -

Introduction to Databases and Data Warehouses

CHAPTER 3 - Relational Database Modeling Part 2

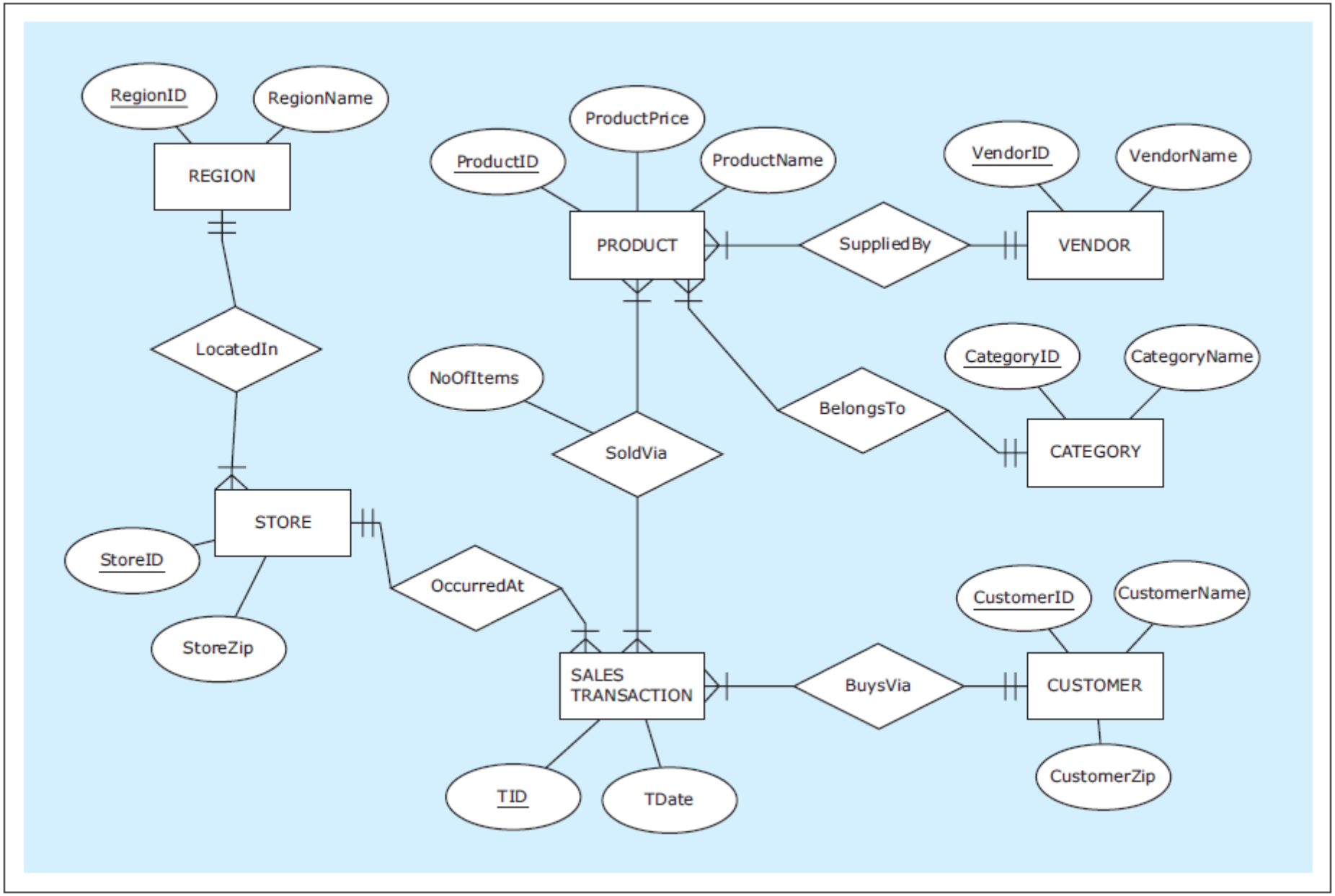
MAIN TOPICS

- Example 1: Map ERD to Relational Schema
- Map Candidate Keys
- Map Multivalued Attributes
- Map Derived Attributes
- Map Entity with Various Attribute Types
- Map Unary Relationships (1:1, 1:M, M:N)

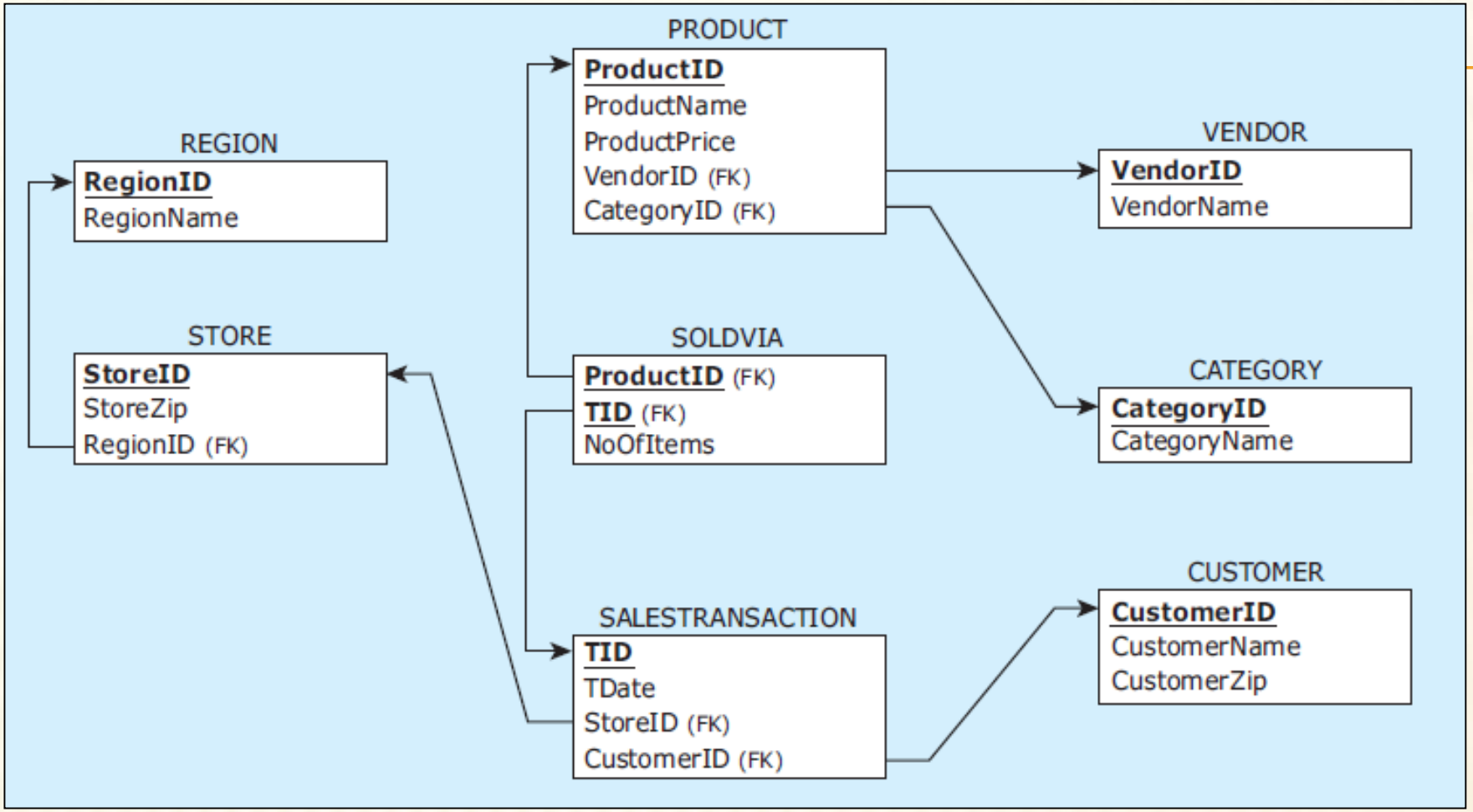
MAPPING ER DIAGRAM INTO RELATIONAL SCHEMA

- **Mapping an ER diagram into a relational schema**
  1. Map all entities and their attributes
     - From left to right and from top to bottom
  2. Map all relationships
     - From left to right and from top to bottom
     - 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 a FK, then add FK
  3. Verify the resulting relational schema
     - Compare the relational schema to the ER diagram

Map Example ER diagram : ZAGI Retail Company Sales Department Database



Example mapped relational schema: ZAGI Retail Company Sales Department Database



Example: Sample data records for the ZAGI Retail Company Sales Department Database

REGION

RegionID	RegionName
C	Chicagoland
T	Tristate

PRODUCT

ProductID	ProductName	ProductPrice	VendorID	CategoryID
1X1	Zzz Bag	$100	PG	CP
2X2	Easy Boot	$70	MK	FW
3X3	Cosy Sock	$15	MK	FW
4X4	Dura Boot	$90	PG	FW
5X5	Tiny Tent	$150	MK	CP
6X6	Biggy Tent	$250	MK	CP

VENDOR

VendorID	VendorName
PG	Pacifica Gear
MK	Mountain King

STORE

StoreID	StoreZip	RegionID
S1	60600	C
S2	60605	C
S3	35400	T

CATEGORY

CategoryID	CategoryName
CP	Camping
FW	Footwear

SALES TRANSACTION

TID	CustomerID	StoreID	TDate
T111	1-2-333	S1	1-Jan-2013
T222	2-3-444	S2	1-Jan-2013
T333	1-2-333	S3	2-Jan-2013
T444	3-4-555	S3	2-Jan-2013
T555	2-3-444	S3	2-Jan-2013

SOLDVIA

ProductID	TID	NoOfItems
1X1	T111	1
2X2	T222	1
3X3	T333	5
1X1	T333	1
4X4	T444	1
2X2	T444	2
4X4	T555	4
5X5	T555	2
6X6	T555	1

CUSTOMER

CustomerID	CustomerName	CustomerZip
1-2-333	Tina	60137
2-3-444	Tony	60611
3-4-555	Pam	35401

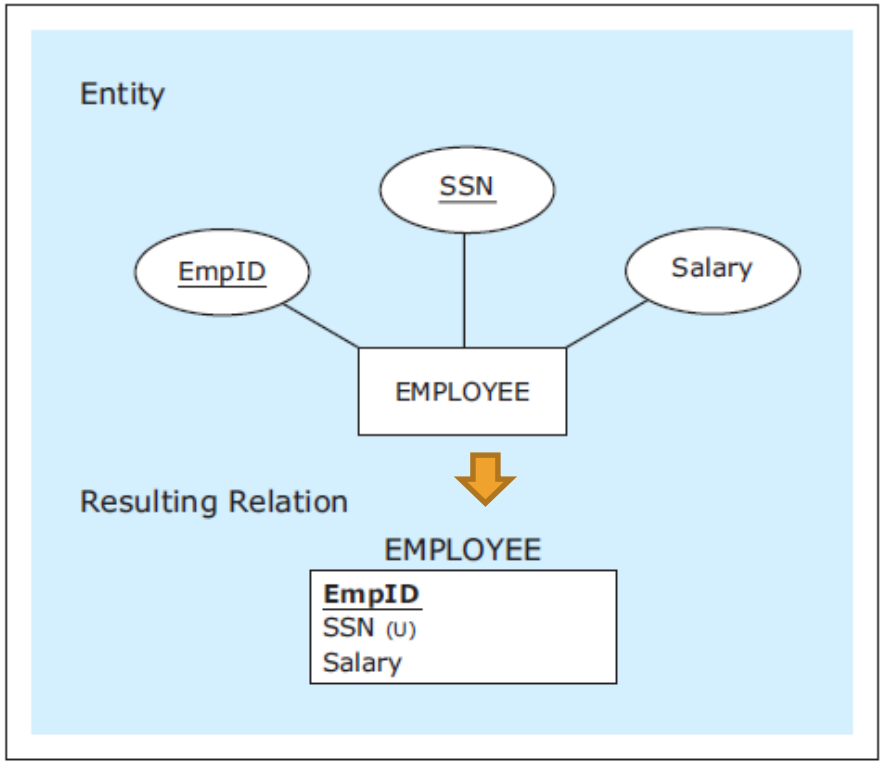
MAPPING CANDIDATE KEYS

- Mapping entities with candidate keys (multiple unique attributes) into relations
  - One of the candidate keys is chosen by database designer as the primary key during the mapping process
  - Other candidate keys are mapped as unique but non-primary key columns

MAPPING ENTITIES WITH CANDIDATE KEYS (MULTIPLE UNIQUE ATTRIBUTES) INTO RELATIONS

Entity with candidate keys mapped into a relation

- Choose one as primary key
- Mark the others with (U)



Sample data records for the mapped relation

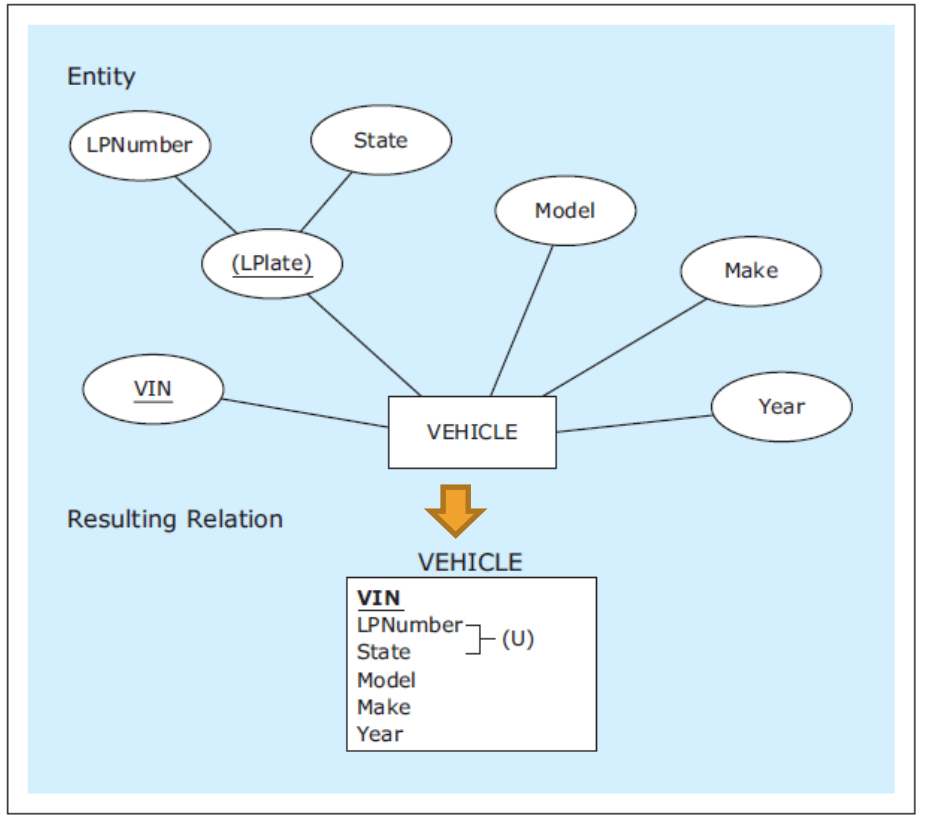
EMPLOYEE

EmpID	SSN	Salary
1234	111-11-1111	$75,000
2345	222-22-2222	$50,000
3456	333-33-3333	$55,000
1324	444-44-4444	$70,000

MAPPING CANDIDATE KEYS

Entity with regular and composite candidate keys mapped into a relation

- Choose non-composite one as primary key
- Mark the others with (U)



Sample data records for the mapped relation

VEHICLE

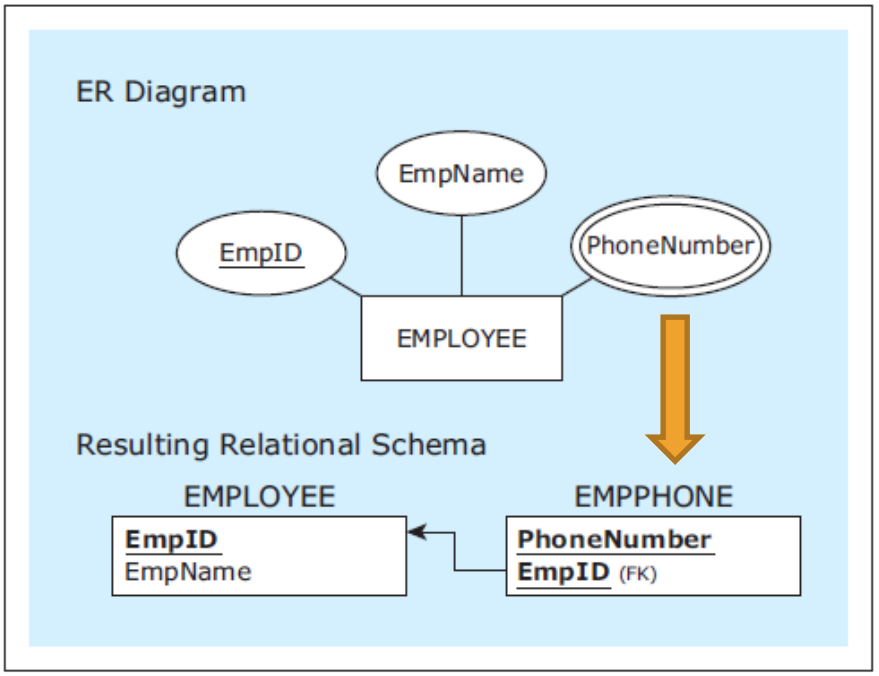
VIN	LPNumber	State	Make	Model	Year
11111	X123	IL	Ford	Fiesta	2012
22222	X456	IL	Ford	Escape	2009
33333	X123	MI	Chevrolet	Volt	2012

MAPPING MULTIVALUED ATTRIBUTES

- **Mapping entities with multivalued attributes into relational database constructs**
  - Map the entity containing the multivalued attribute to an entity **without** the multi-valued attribute
  - Map the multi-valued attribute to a separate new relation with
    - Two columns
      - One column -- the multivalued attribute
      - One foreign key column referring to the primary key of the relation for the entity itself
    - A composite primary key consisting of
      - Both columns in the separate new relation

MAPPING MULTIVALUED ATTRIBUTES

Entity with multivalued attributes mapped into 2 relations



Sample data records for the mapped relations

EMPLOYEE

EmpID	EName
1234	Becky
2345	Molly
3456	Rob
1324	Ted

EMPPHONE

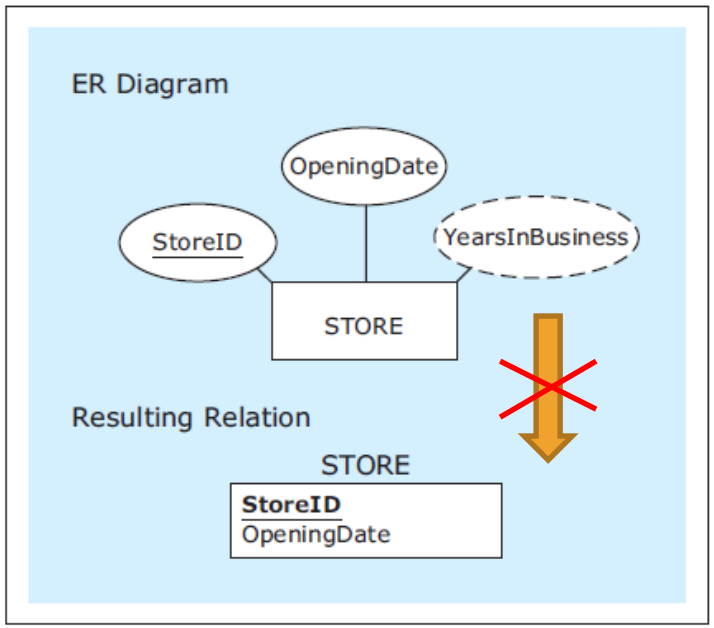
EmpID	PhoneNumber
1234	630-111-4567
1234	630-222-4567
2345	630-333-4567
3456	630-111-4567
3456	630-444-4567
1324	630-111-4567
1324	630-555-4567
1324	630-666-4567

MAPPING DERIVED ATTRIBUTES

- **Mapping derived attributes**
  - Derived attributes
    - Not stored in the database
    - Computed based on stored values of other attributes and/or additional data
  - Not add anything for derived attributes in the relational schema
  - Implement derived attributes in the database front-end application

MAPPING DERIVED ATTRIBUTES

Entity with derived attributes mapped into a relation



Sample data records for the mapped relation

STORE (RELATION)

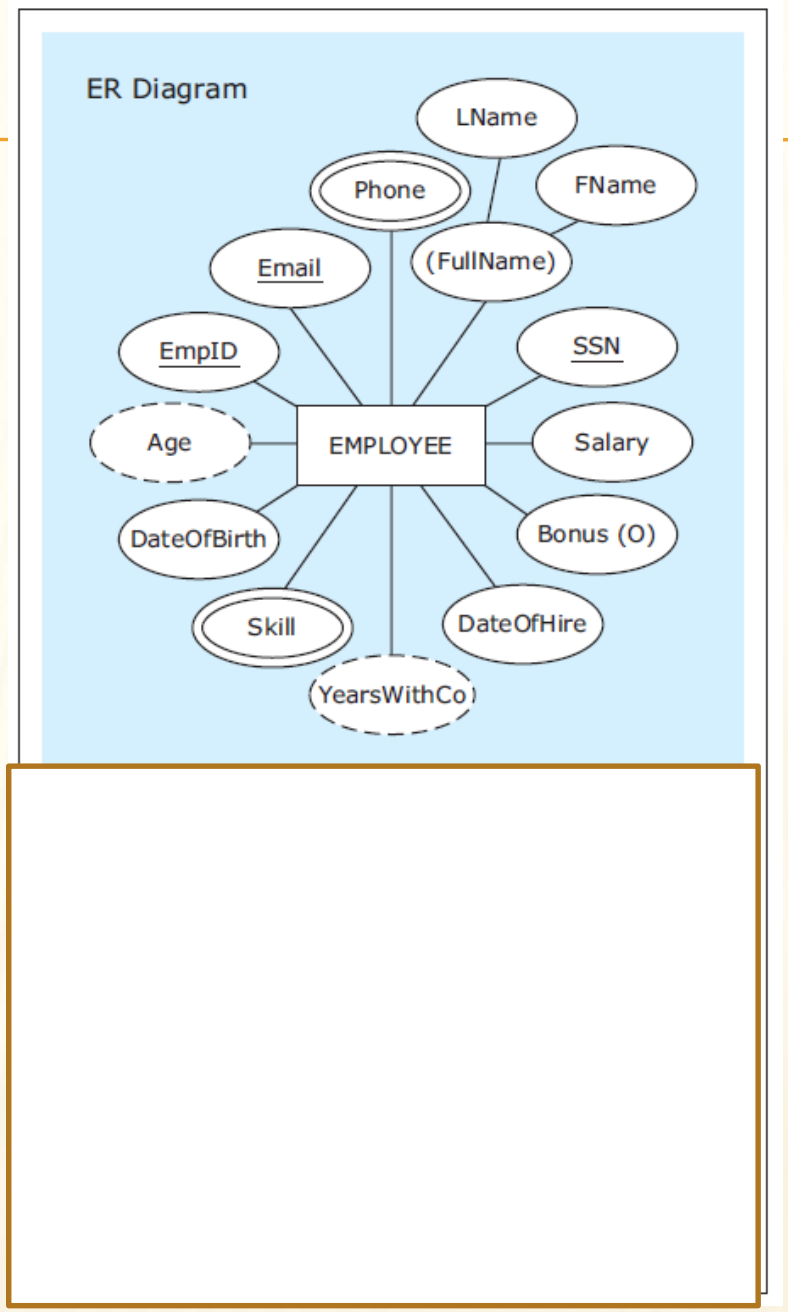
StoreID	OpeningDate
1111	1.1.2000
2222	2.2.2001
3333	3.3.2002
4444	2.2.2001

The relation presented to a user in a front-end application

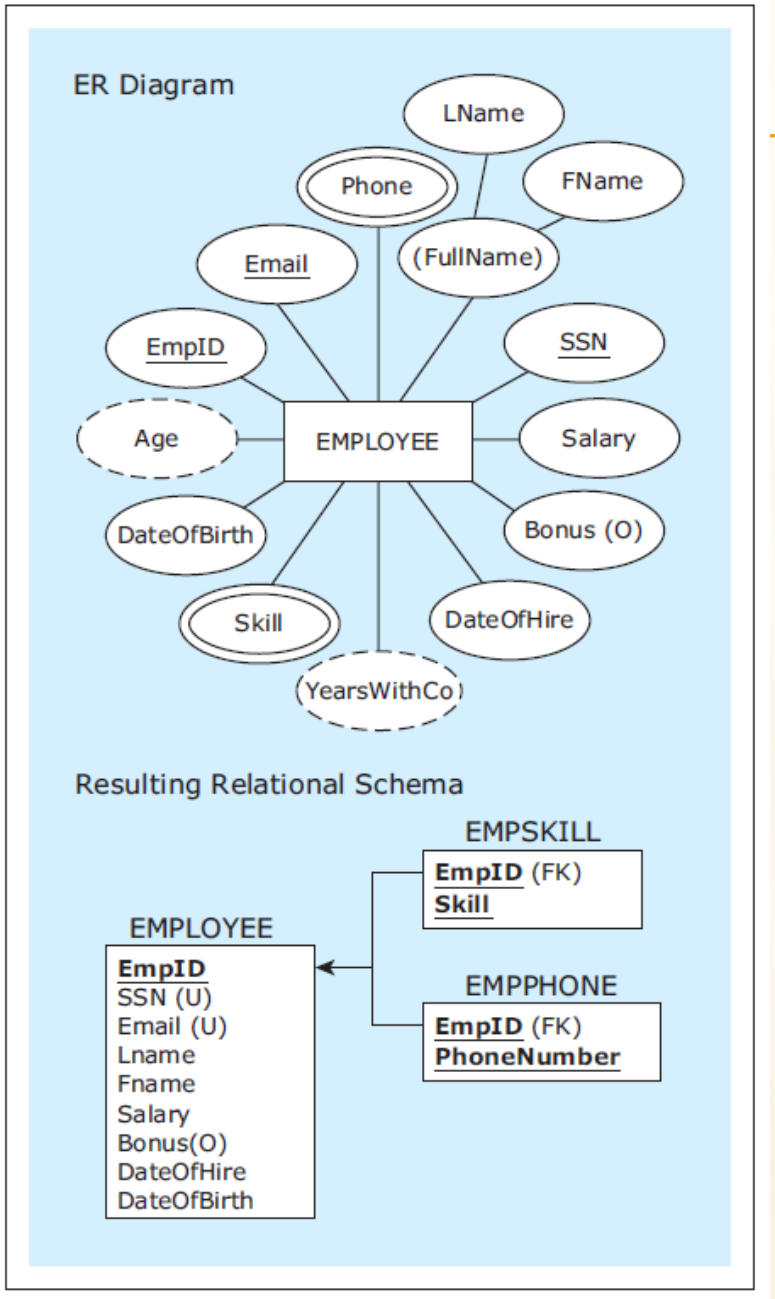
STORE

Sid	OpeningDate	YearsInBusiness
1111	1.1.2000	13
2222	2.2.2001	12
3333	3.3.2002	11
4444	2.2.2001	12

Example : Entity with various types of attributes mapped into a relation



Example : Entity with various types of attributes mapped into a relation



Example : Sample data records for the mapped relations

EMPLOYEE

EmpID	SSN	Email	FName	LName	Salary	Bonus	DateOfHire	DateOfBirth
1234	111-11-1111	bk@compx.com	Becky	Kaiser	$75,000		1.1.2002	11.12.1970
2345	222-22-2222	mn@compx.com	Molly	Neps	$50,000	$10,000	2.2.2002	9.8.1973
3456	333-33-3333	rd@compx.com	Rob	Duzs	$55,000	$4,000	3.4.2003	11.11.1976
1324	444-44-4444	ti@compx.com	Ted	Lovett	$70,000		9.8.2004	5.6.1971

EMPPHONE

EmpID	PhoneNumber
1234	630-111-4567
1234	630-222-4567
2345	630-333-4567
3456	630-111-4567
3456	630-444-4567
1324	630-111-4567
1324	630-555-4567
1324	630-666-4567

EMPSKILL

EmpID	Skill
1234	CPA
1234	CFP
2345	CPA
3456	CPA
3456	CFP
3456	CPP
1324	CFP

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