

Data Modeling

- A technique used in Database Design
- Like an architect's drawings of a house being built
 - The architect draws the model of the database
 - The technicians (DBAs for example) then build the database according to the architect's design
- Different techniques
 - [iDEF1X](#)
 - [Crows' Feet](#)
 - [Chen](#)

Data Modeling

- Different tools
 - [data modeling tools](#)
- Why?
 - Repository of all database information, stored outside of the database
 - Automate the creation of DDL
 - Enforces design consistency
 - Easy for customers to understand
 - Enforces 3NF

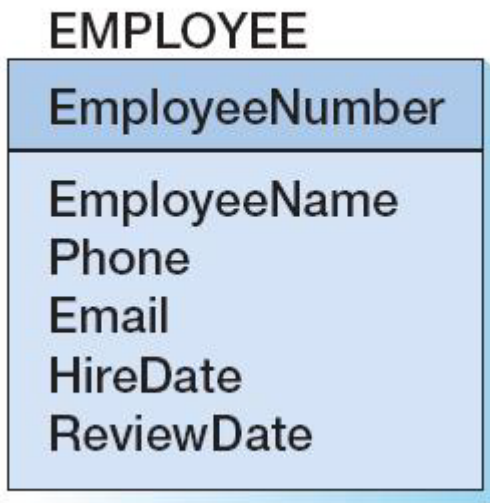
Data Modeling

- Process
 1. Gather all data requirements
 2. Normalize the data to 3rd Normal Form
 3. From 3NF schemas, draw the Data Model (ERD)
 4. Review the ERD with your customers verifying it against the requirements
 5. Upon signoff, generate DDL



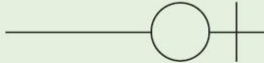
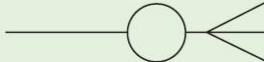
Data Modeling

- Symbols you will use in data modeling

Entity (rectangle) with an entity name, Primary Key, and Attributes listed



Cardinality & Optionality Symbols

Symbol	Meaning
	One—Mandatory
	Many—Mandatory
	One—Optional
	Many—Optional

Data Modeling

- Cardinality
 - How many of THESE are related to how many of THESE
 - Typically: zero, one, or many
 - On both ends of the relationship
- Optionality
 - Is the relationship mandatory (one or more) or optional (zero)

Data Modeling

- Prepare for Data Modeling
 - Once data requirements are clear, then
 - Decide the **Business Area** you are modeling
 - NOTE: Failure to restrict your model to a single business area will make the data modeling process much more complex
 - Organize all the data items into **ENTITIES** and **ATTRIBUTES**
 - Determine an attribute that can serve as a **PRIMARY KEY** for each entity
 - If no appropriate candidate keys exist, then plan to create a **SURROGATE** key

Data Modeling

Begin the process of Data Modeling

1. Draw a rectangle to represent each **ENTITY**
2. Write the **NAME** of the entity above the rectangle (entity names should be singular)
3. Draw a **RELATIONSHIP** line between each related entity
4. Draw **CARDINALITY** and **OPTIONALITY** symbols on both ends of each relationship line
5. Resolve any many-to-many relationships by creating an **ASSOCIATION** (“child”) entity between the two “parent” entities

Data Modeling

1. Draw a horizontal line across each entity rectangle, and enter the name of the **primary key** attribute above the line
 1. NOTE: As you define primary keys and group the attributes within entities, you will **NORMALIZE** the data
2. Then list all the remaining **attributes** within the rectangle below the line
3. Identify any **foreign key** attributes with an “(FK)”
4. **Walk through** the model with your customers

Data Modeling

Let's Practice using the schemas from the chair company.

	A	B	C	D	E	F	G	H	I
1		UNNORMALIZED		FIRST NORMAL FORM		SECOND NORMAL FORM		THIRD NORMAL FORM	
2		Customer Order		Customer Order		Customer Order		Order	
3		Order Number		Order Number		Order Number		Order Number	
4		Order Date		Order Date		Order Date		Order Date	
5		Delivery Date		Delivery Date		Delivery Date		Delivery Date	
6		Customer Discount		Customer Discount		Customer Discount		discount amount	
7		discount amount		discount amount		discount amount		invoiced amount	
8		invoiced amount		invoiced amount		invoiced amount		customer number	
9		customer number		customer number		customer number		order total	
10		customer name		customer name		customer name			
11		Contact		Contact		Contact		Customer	
12		ContactType		ContactType		ContactType		customer number	
13		bill to address		bill to address		bill to address		customer name	
14		bill to city		bill to city		bill to city		Contact	
15		bill to state		bill to state		bill to state		ContactType	
16		bill to zip		bill to zip		bill to zip		bill to address	
17		ship to address		ship to address		ship to address		bill to city	
18		ship to city		ship to city		ship to city		bill to state	
19		ship to state		ship to state		ship to state		bill to zip	
20		ship to zip		ship to zip		ship to zip		ship to address	
21	---	Product Number		order total		order total		ship to city	
22		Description		OrderProduct		OrderProduct		ship to state	
23		quantity ordered		Order number		Order number		ship to zip	
24	---	unit price		Product Number		Product Number		OrderProduct	
25		order total		Product Description		Quantity		Order number	
26				Quantity		unit price		Product Number	
27				unit price		total		Quantity	
28						Product		unit price	
29						Product Number		total	
30						Product Description		Product	
31								Product Number	
32								Product Description	
33									

-
- Stop at this point and do a demo on the board.

Data Modeling

“Reading the Relationships”

- An order belongs to one customer
- A customer can place zero, one or many orders
- An order may contain one or many OrderDetails
- A product may be purchased on zero, one or many OrderDetails

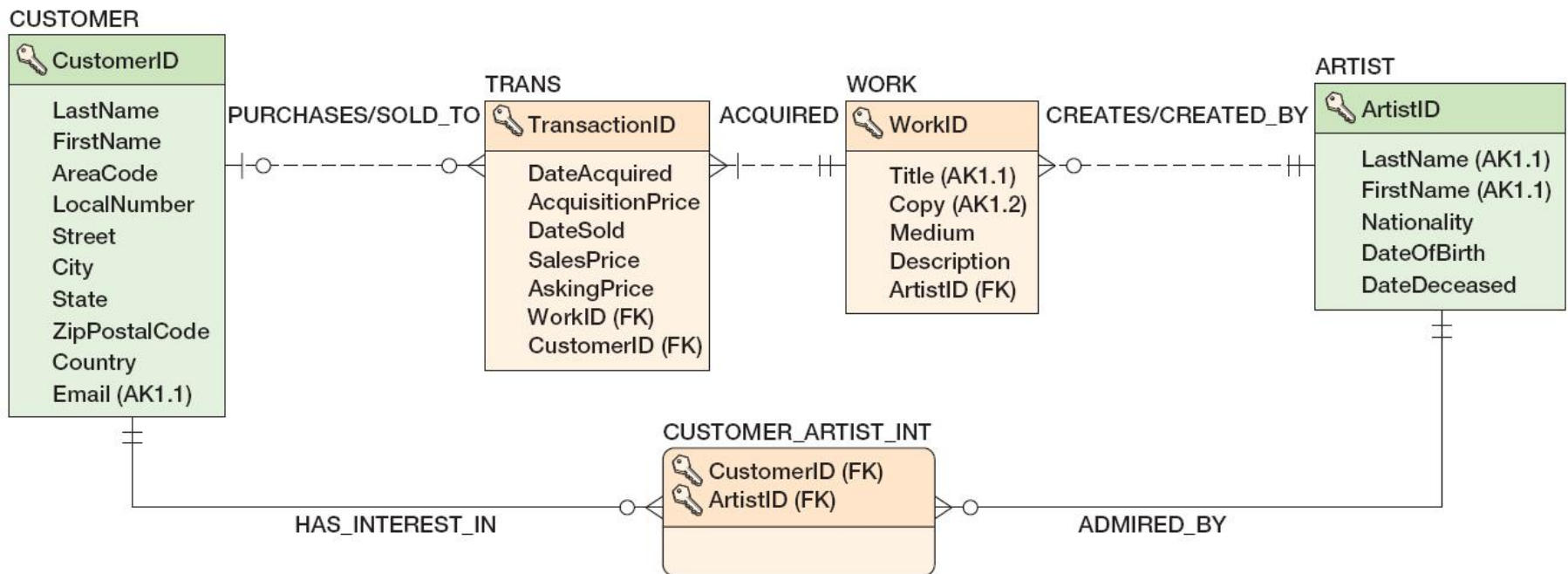
Data Modeling

“Reading the Relationships”

- Always read clockwise
- Avoid “has” as a verb

Data Modeling

- An example:



Look at this data model, then consider the questions on the next slide.

Data Modeling

- What are the names of the five entities?
- What is the primary key of each entity?
- Which one is an association entity?
- Why are some of the relationship lines dashed, and some are solid?
- Why do 4 of the entities have square corners and one has rounded corners?
- Which entity has a composite (or “concatenated”) key?
- Relationship descriptions should be read clockwise: a customer purchases a work; a work is sold to a customer. Which entity represents the fact that a customer purchased a work?

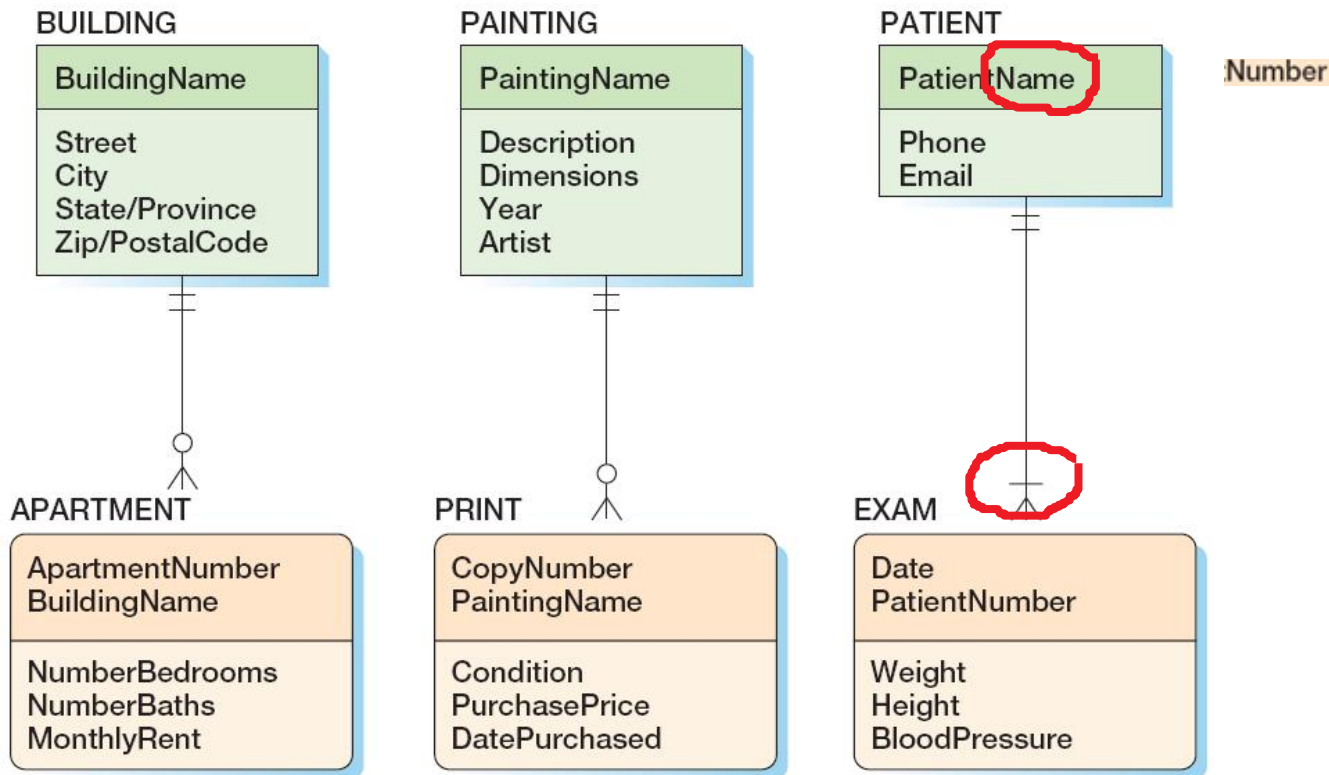
Data Modeling

More Model Constructs

- Square Edge = “Independent Entities”
- Round Edge = “Dependent Entities” (“weak”)
- Dashed Line = a dependent entity where the parent’s key does not migrate to primary
- Solid Line = a dependent entity where the parent’s key migrates to primary

Dependent Entities

- ID Dependent Entities



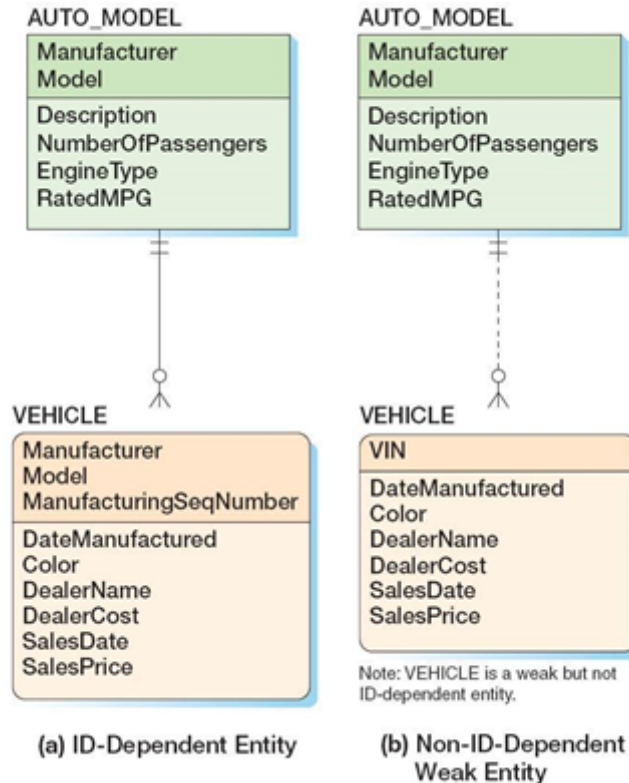
(a) APARTMENT is
ID-Dependent on
BUILDING

(b) PRINT is
ID-Dependent
on PAINTING

(c) EXAM is
ID-Dependent
on PATIENT

Dependent Entities

- Non-ID Dependent Weak Entities

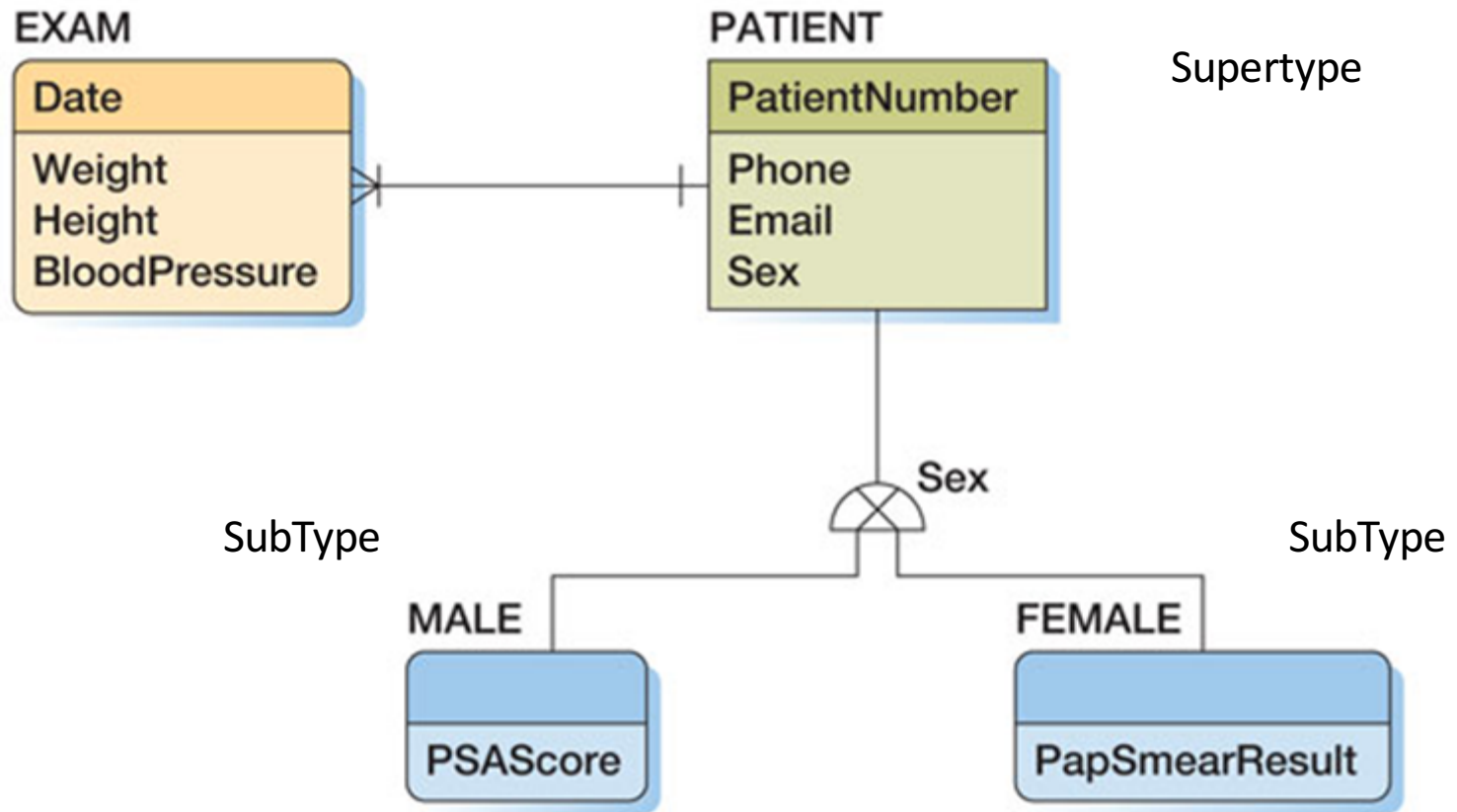


Data Modeling

More Model Constructs

- Subtype/Supertype
 - The supertype contains all common attributes, while the subtypes contain specific attributes.
 - The supertype may have a **discriminator** attribute which indicates the subtype.

Data Modeling



Data Modeling

Drawing your data models

- Reasonable Free Tools:
 - [MySQLWorkbench](#)
 - [Lucidchart \(free trial\)](#)
 - [TOADModeler \(free trial\)](#)
 - [Oracle SQL DEVELOPER](#)
 - [ErWin](#)

Other Modeling Concepts

- Recursive
- Resolving a many-to-many