



**BENEMÉRITA UNIVERSIDAD  
AUTÓNOMA DE PUEBLA**

**FACULTAD DE CIENCIAS DE LA COMPUTACIÓN**

**Material Didáctico**

**Bases de Datos**

**Otoño 2002**

**MC David Eduardo Pinto Avendaño**

Diapositiva  
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Benemérita Universidad Autónoma de Puebla  
Facultad de Ciencias de la Computación

Development of DataBase Schemas

Basic Knowledge

MC. David Eduardo Pinto Avendaño

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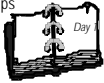
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Agenda

1. Introduction
2. Overview of database development
3. Modeling basic entities
4. Modeling relationships
5. Adding detail to the diagram
6. Unique Identifiers
7. Resolving many to many relationships



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Diapositiva  
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Agenda

8. Modeling hierarchies, networks and roles
9. Modeling complex structures
10. Conceptual modeling review
11. Initial database design
12. Mapping exclusive relationships and entities to tables
13. Normalization



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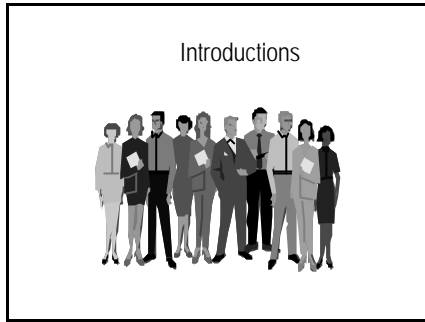
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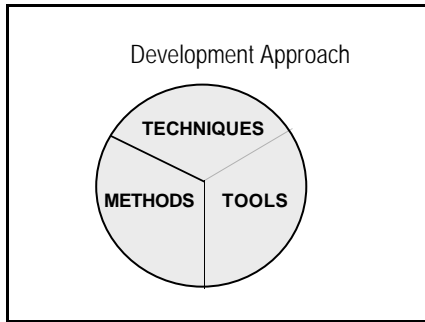
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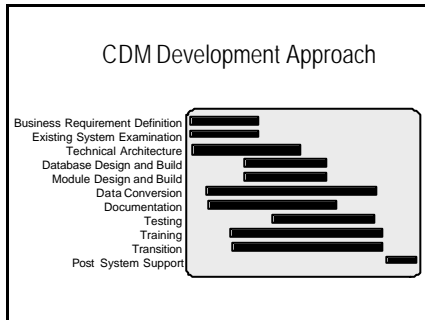
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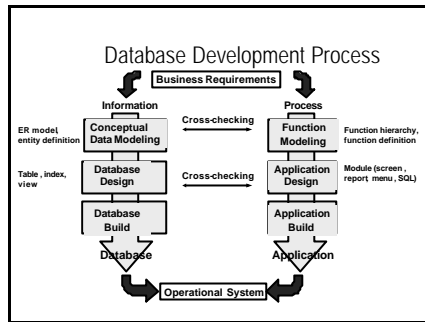
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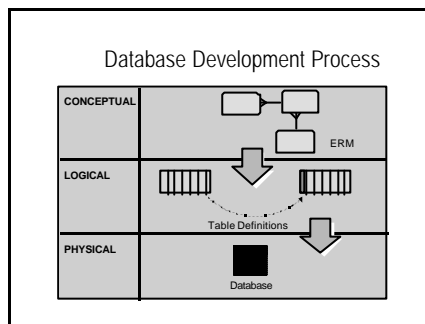
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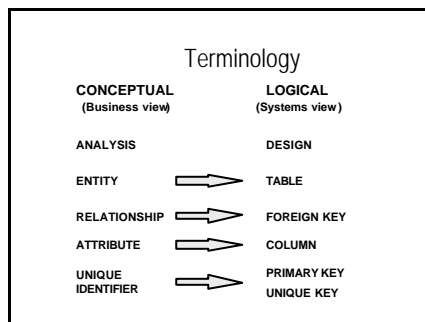
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**Business Information Requirements**

"I manage the Human Resources Department for a large company. We need to keep information about each of our company's employees. We need to track each employee's first name, last name, job or position, hire date and salary. For any employees on commission, we also need to track their potential commission. Each employee is assigned a unique employee number.

Our company is divided into departments. Each employee is assigned to a department, for example, accounting, sales or development. We need to know the department responsible for each employee and the department's location. Each department has a unique number, for example, accounting is 10 and sales is 30.

Some of the employees are managers. We need to know each employee's manager and the employees that each manager manages."

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**Entity Definitions**

- ✦ An object of interest to the business
- ✦ A class or category of thing
- ✦ A named thing
- ✦ A noun
- ✦ A thing of significance about which the business needs information

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**Attribute Definitions**

- ✦ Nouns used to describe entities
- ✦ Specific pieces of information which need to be known
- ✦ An entity should have attributes

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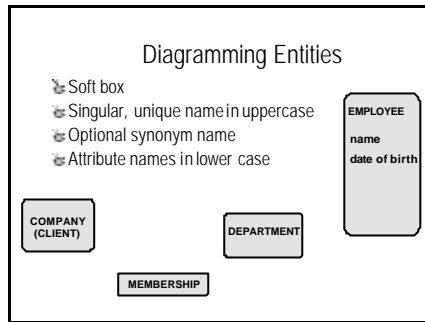
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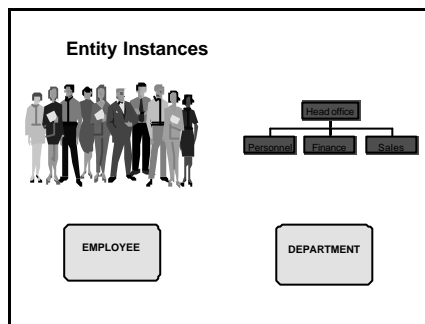
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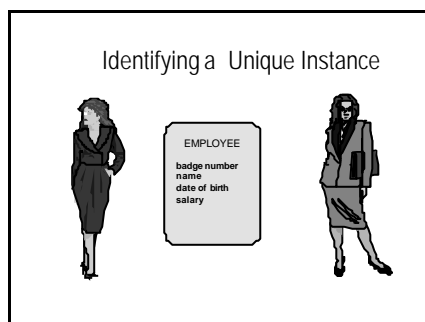
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**Identify and Model Entities**

- ✚ Identify a noun
  - Is it significant?
  - Is there information about it that the business needs to keep?
  - Is it a group or an instance?
- ✚ Name the entity
- ✚ Write a description of it
- ✚ Identify a few attributes
- ✚ Draw a soft box for it

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**In Class Exercise - Solution**

"I am the manager of a training company that provides instructor-led COURSEs in management techniques. We teach courses, each of which has a code, a name, and a fee. Introduction to UNIX and C Programming are two of our more popular courses.

Courses vary in length from one to four days. Paul Rogers and Maria Gonzales are two of our best teachers. We need each INSTRUCTOR's name and phone number. The STUDENTS can take several courses over time, and many do this. Jamie Brown from AT&T took every course we offer!

We like to have each student's name and phone number."

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**In Class Exercise - Solution**

<b>COURSE</b>  code name fee length	<b>INSTRUCTOR</b>  name phone no.	<b>STUDENT</b>  name phone no.
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Relationship Definitions

- ✦ The way one entity relates to another
- ✦ The business rules that link together business information needs
- ✦ What one thing has to do with another
- ✦ A named association between entities

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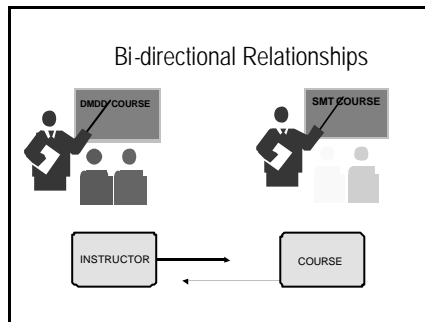
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Diagramming Conventions

- ✦ A line between two entities
- ✦ Lower case relationship name
- ✦ Optionality (Minimum cardinality)
  - Mandatory - *must be*
  - - - - - Optional - *may be*
- ✦ Degree (Maximum cardinality)
  - One or more
  - One and only one

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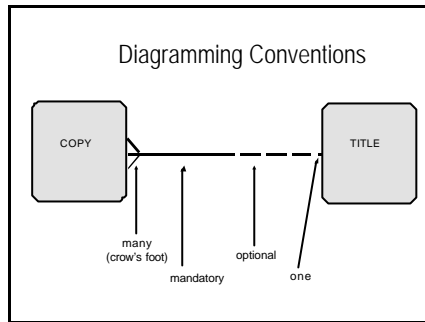
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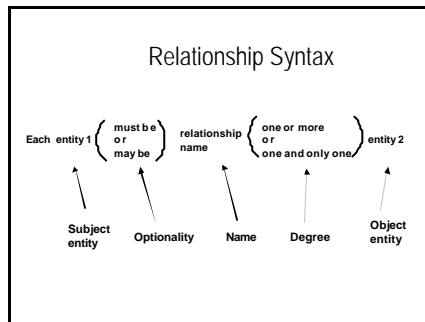
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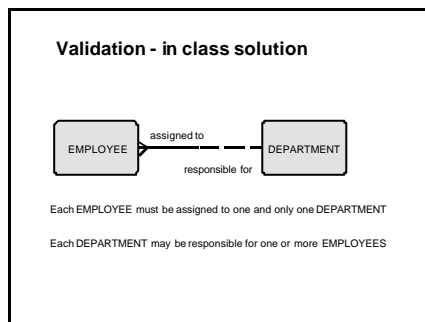
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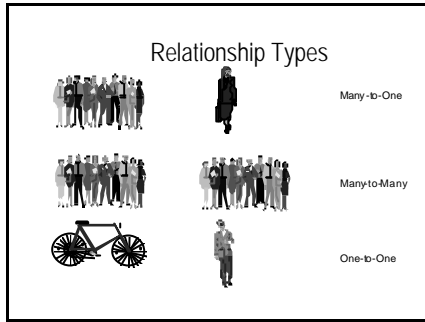
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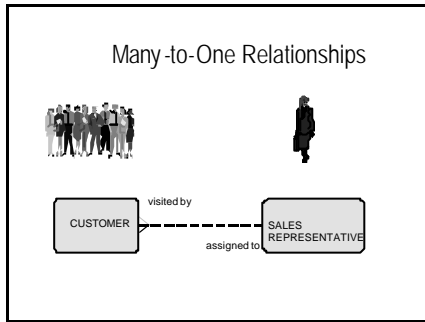
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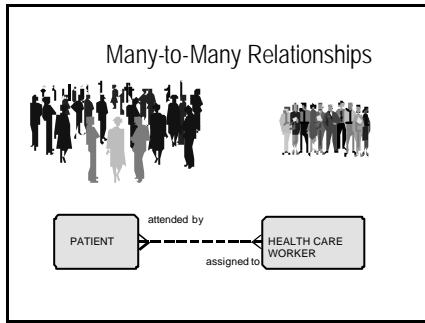
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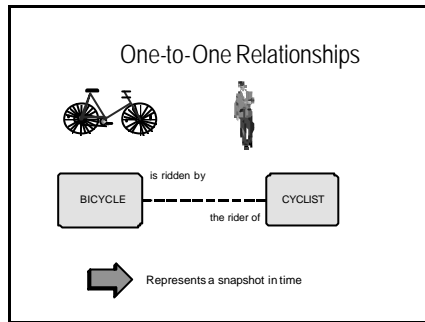
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- Analyzing and Modeling Relationships
- 1 Determine the existence of a relationship
  - 2 Name each direction of the relationship
  - 3 Determine the degree of each direction of the relationship
  - 4 Determine the optionality of each direction of the relationship
  - 5 Read the relationship aloud to validate it

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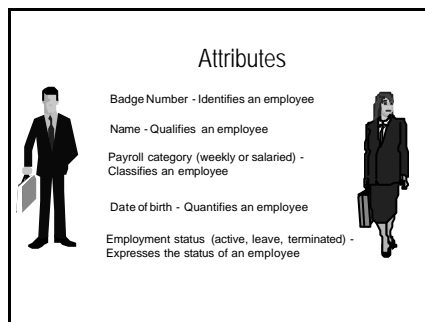
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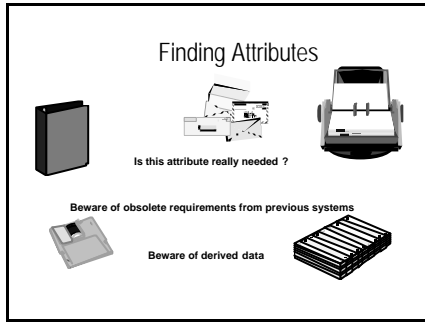
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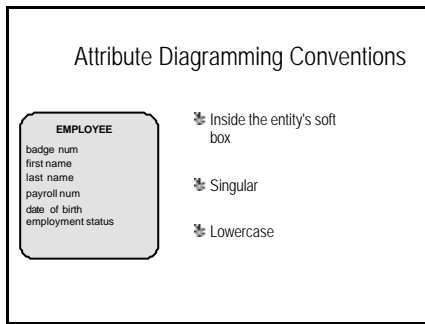
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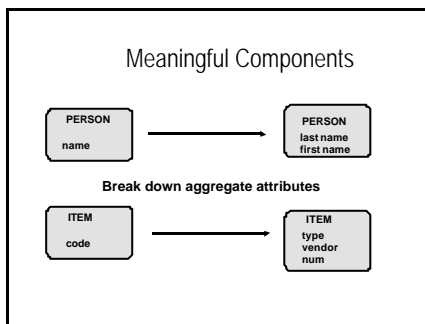
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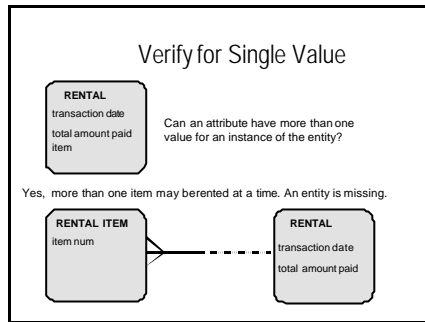
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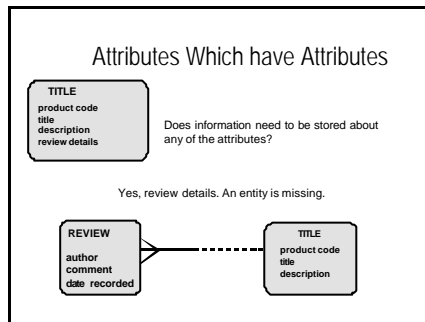
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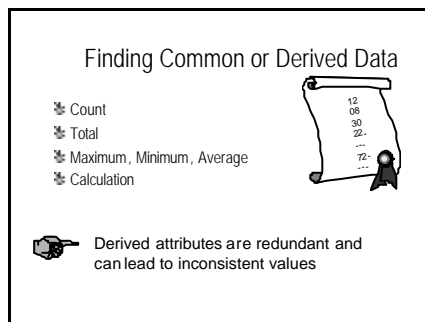
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Attribute Optionality

**Mandatory Attributes**  
✱ A value must be stored for each entity instance

✱ Tagged with \*

**Optional Attributes**  
✱ A value may be stored for each entity instance

✱ Tagged with O

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Attribute Optionality

EMPLOYEE

- ✱ badge num
- ✱ first name
- ✱ last name
- O title
- O weight

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Attribute Details and Volumes



Attribute - \* Engine Size

Format	Type	Number
	Maximum length	4
	Average length	4
	Decimal place	1
	Unit of measure	cc
	Allowable values	900,1000,1500,1800,2000
Volume	Initial	100%

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**Unique Identifier Definition**

Each entity instance must be able to be uniquely identified



A combination of attributes or relationships that serve to identify a specific instance of an entity.

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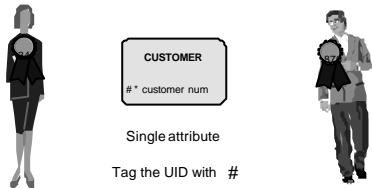
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**Simple Unique Identifier**



**CUSTOMER**

# \* customer num

Single attribute

Tag the UID with #

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**Compound UID - Attributes**



**MEMBERSHIP**

# \* num  
# o start date

Multiple attributes

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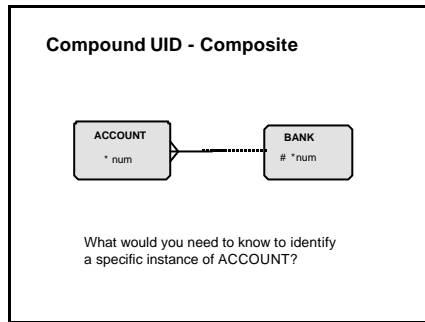
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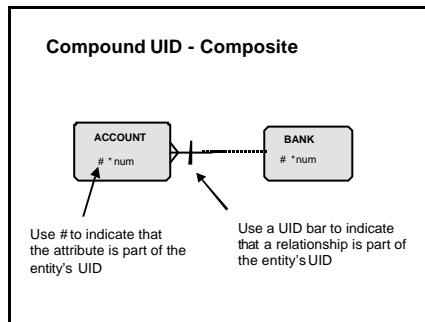
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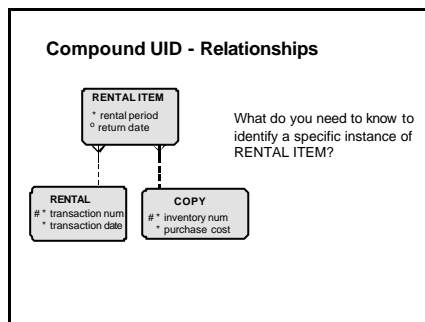
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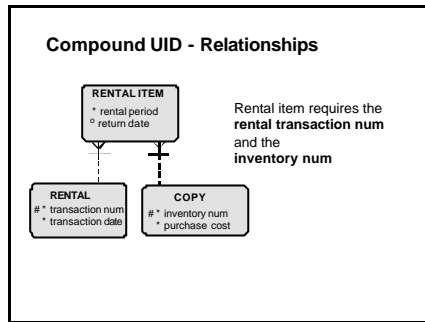
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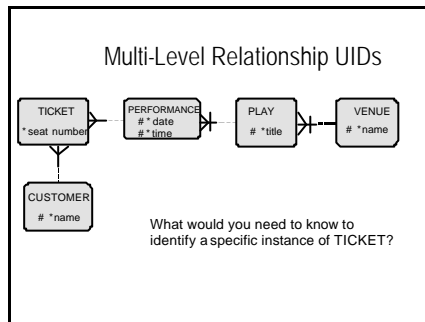
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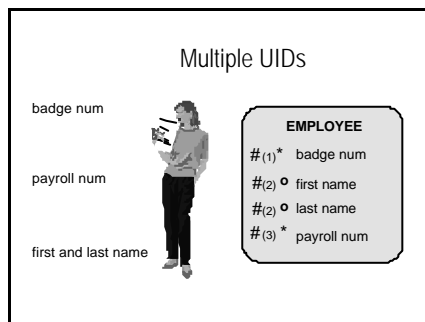
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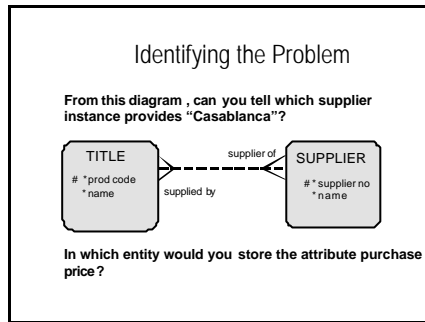
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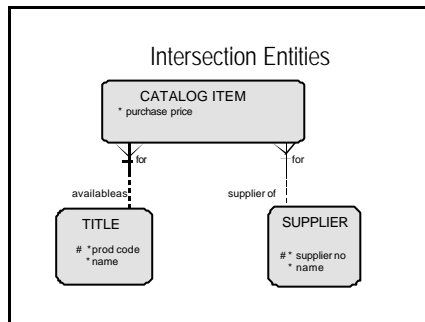
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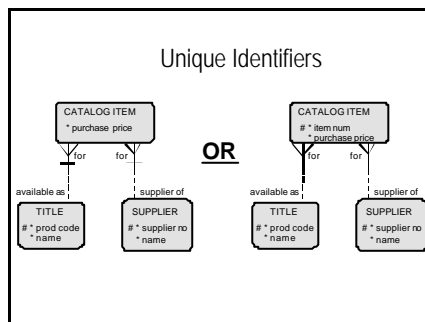
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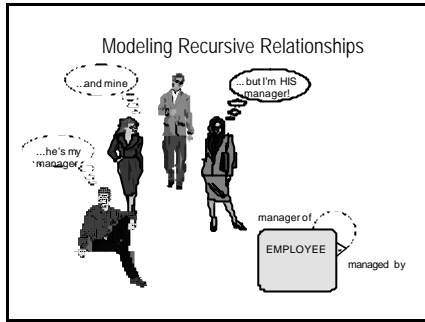
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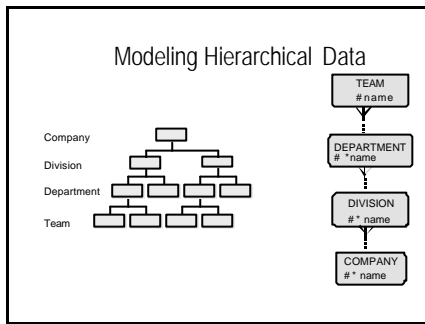
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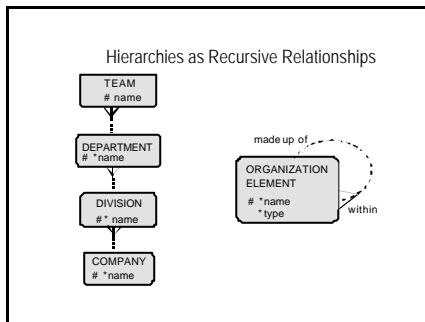
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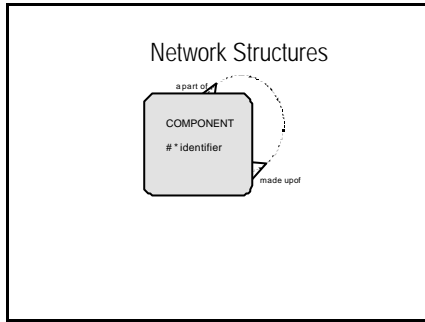
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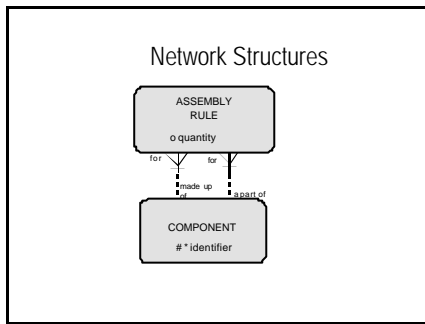
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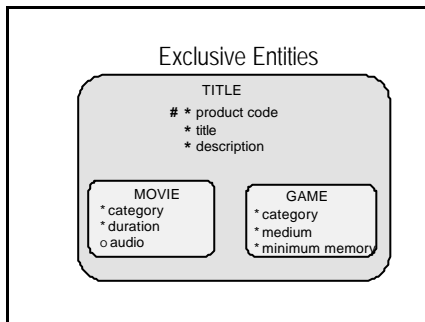
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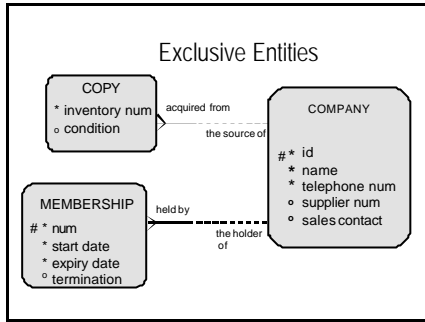
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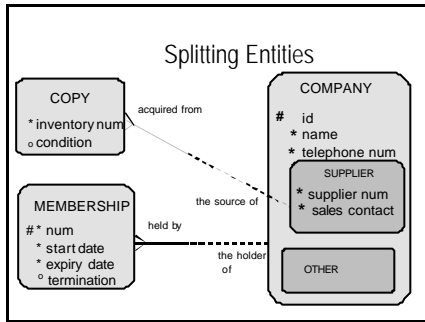
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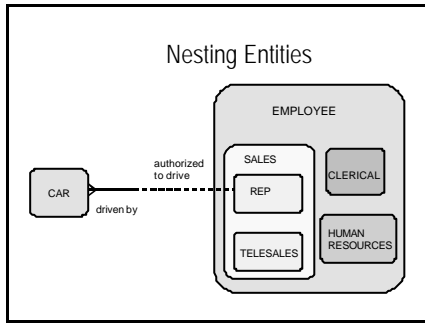
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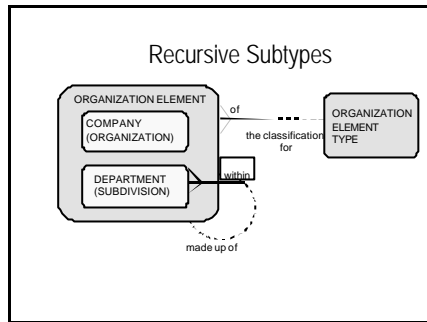
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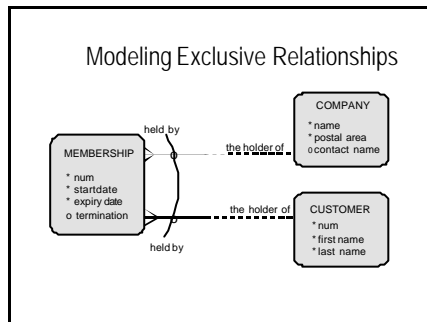
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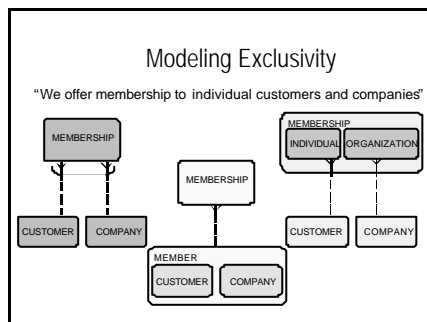
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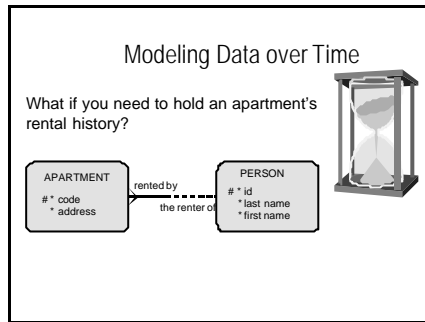
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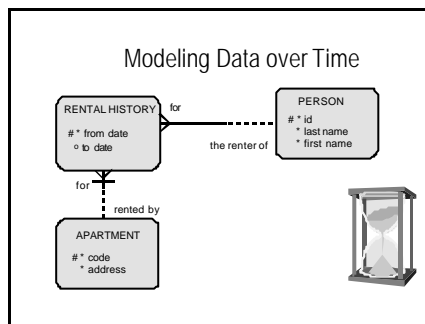
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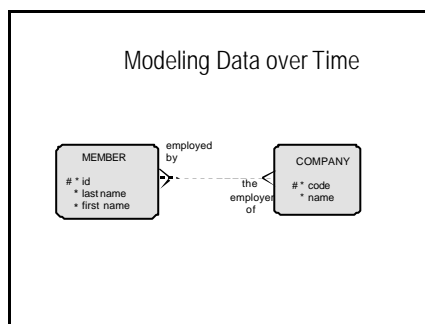
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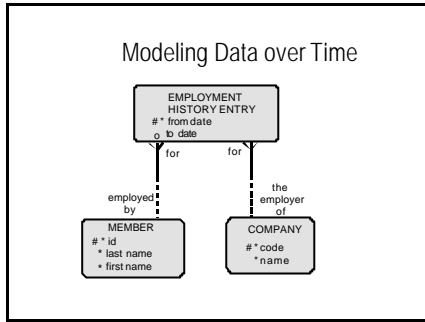
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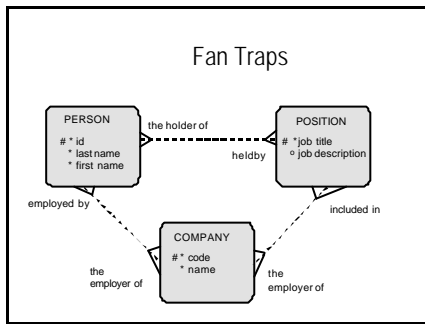
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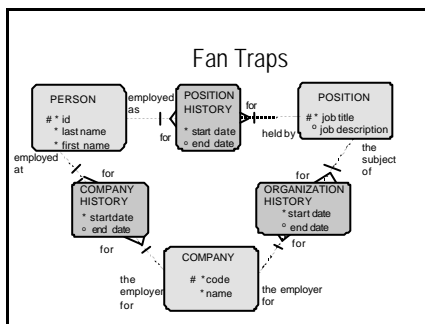
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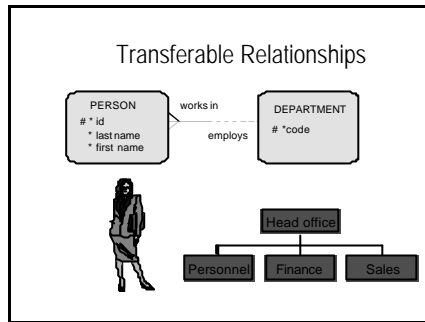
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Diapositiva  
70



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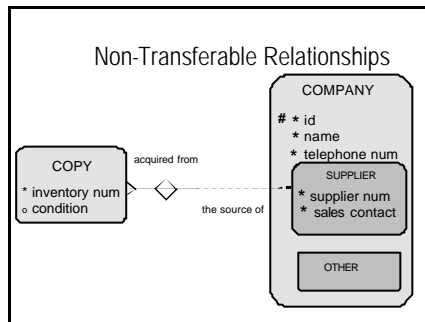
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Diapositiva  
71



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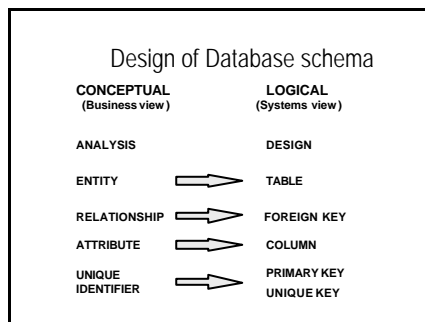
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Diapositiva  
72



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Diapositiva  
73

### Creating the Outline Design

- 1 Map simple entities to tables
- 2 Map attributes to columns and document sample data
- 3 Map unique identifiers to primary keys
- 4 Map relationships to foreign keys

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Diapositiva  
74

### Mapping Simple Entities

Table Name: **EMPLOYEES**

**EMPLOYEE**

# badge num  
# payroll num  
# first name  
# last name  
o position

Column name	BADGE_NUM	PAYROLL_NUM	FIRST_NAME	LAST_NAME	POSITION	
Key type	PK	UK1	UK2	UK2		
Nulls	NN	NN	NN	NN		
Sample data						

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Diapositiva  
75

### Mapping Relationships - M:1

Table Name: **EMPLOYEES**

**EMPLOYEE**

# badge num  
# payroll num  
# first name  
# last name  
o position

1

**DEPARTMENT**

# num  
\* name

Column name	BADGE_NUM	PAYROLL_NUM	FIRST_NAME	LAST_NAME	POSITION	DEP_NUM
Key type	PK	UK1	UK2	UK2		FK
Nulls	NN	NN	NN	NN		NN
Sample data						

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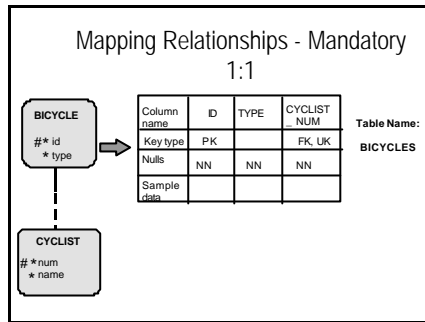
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Diapositiva  
76




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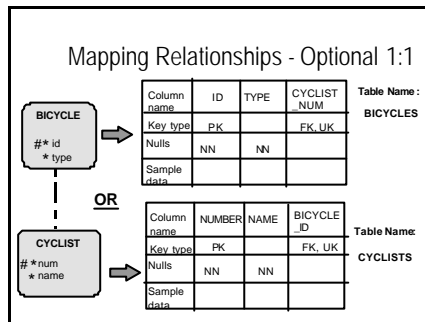
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Diapositiva  
77




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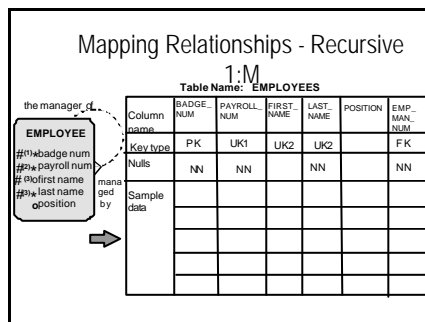
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Diapositiva  
78




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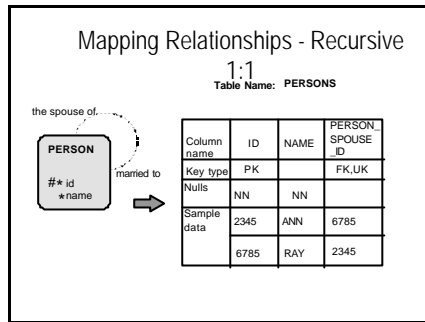
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Diapositiva 79



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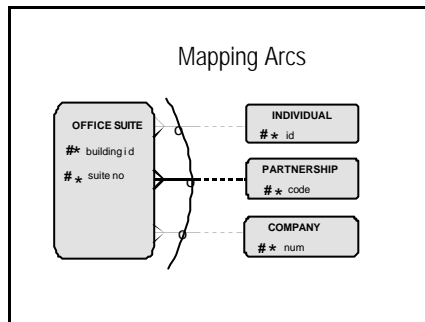
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Diapositiva 80



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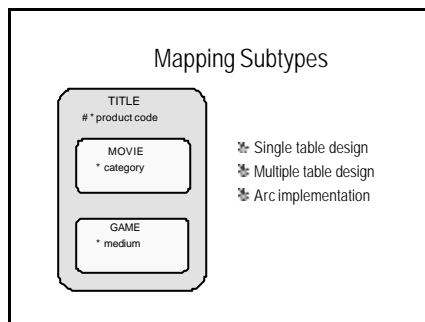
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Diapositiva 81



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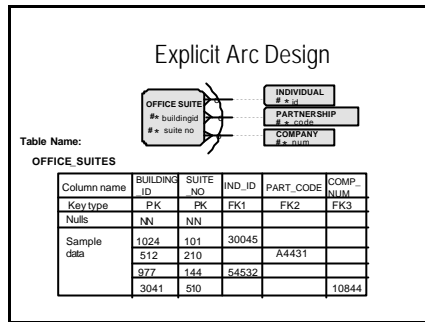
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Diapositiva  
82




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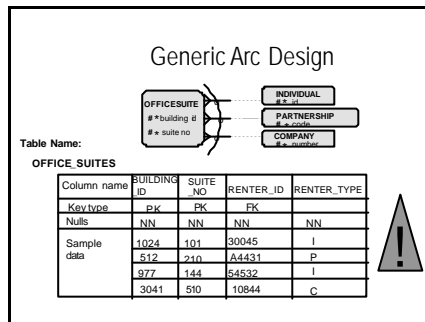
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Diapositiva  
83




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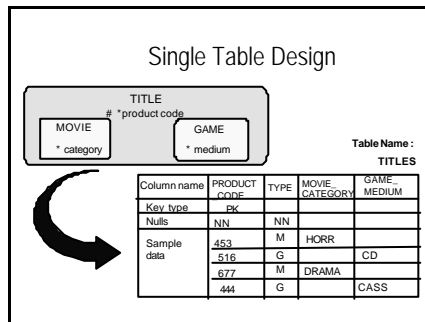
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Diapositiva  
84




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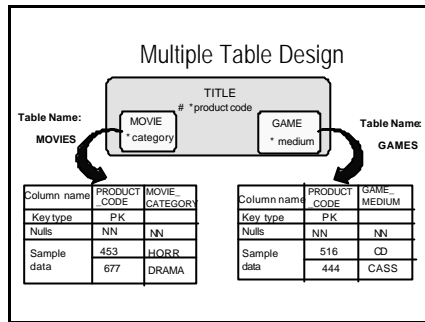
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Diapositiva  
85




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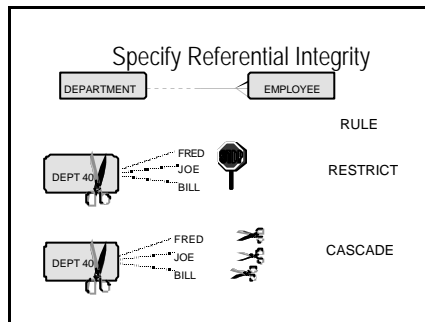
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Diapositiva  
86




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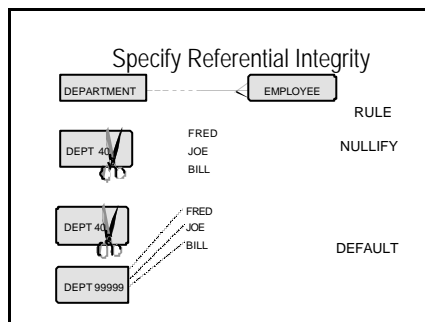
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Diapositiva  
87




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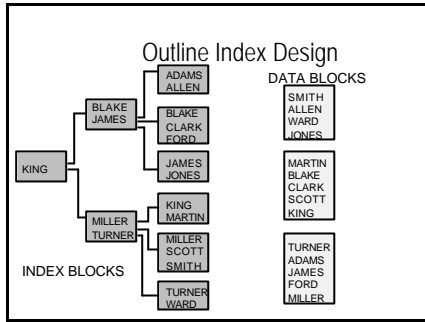
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Diapositiva  
88



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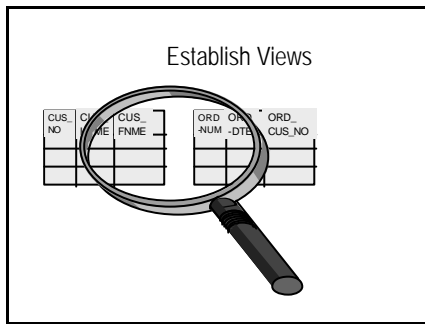
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Diapositiva  
89



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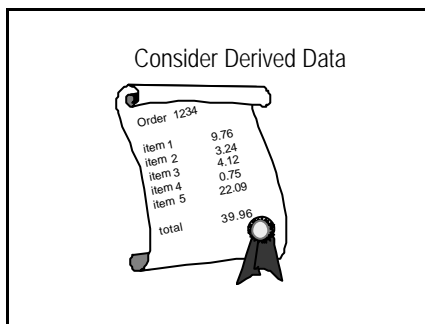
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Diapositiva  
90



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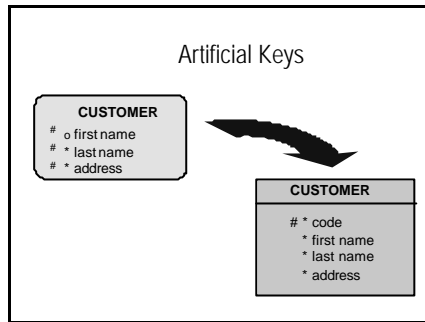
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Diapositiva  
91



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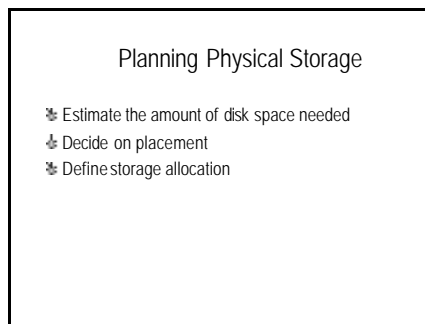
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Diapositiva  
92



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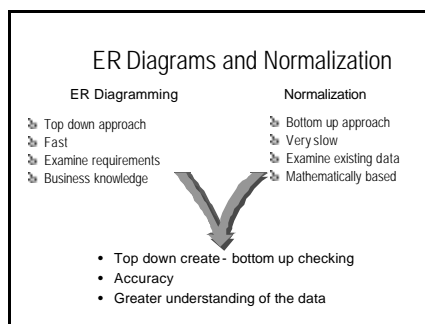
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Diapositiva  
93



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Diapositiva  
94

### Rules of Normalization

- ✳ Collect and list the raw data ONF
- ✳ Remove repeating groups 1NF
- ✳ Remove part key dependencies 2NF
- ✳ Remove inter-data dependencies 3NF
- ✳ Remove inter-key dependencies BC NF
- ✳ Test and identify transitive dependencies
- ✳ Optimize
- ✳ Retest
- ✳ Draw and use the model

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Diapositiva  
95

### Collect the Raw Data

customer name  
John Doe  
order 12345  
product A453  
desc. Bows  
quantity 6  
address anytown any place  
date 03/04/96

ONF  
1NF  
2NF  
3NF  
BC NF  
Test  
Optimize  
Retest

ONF  
# customer name  
order num  
product num  
product description  
quantity ordered  
customer address  
dateordered

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Diapositiva  
96

### Remove Repeating Groups

ONF  
# customer name  
order num  
product num  
product description  
quantity ordered  
customer address  
date ordered

1NF  
# customer name  
customer address  
# customer name FK  
order num  
product num  
product description  
quantity ordered  
dateordered

ONF  
1NF  
2NF  
3NF  
BC NF  
Test  
Optimize  
Retest

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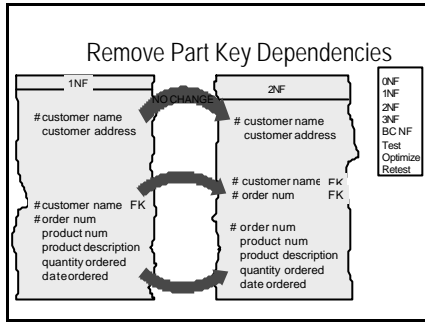
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Diapositiva  
97




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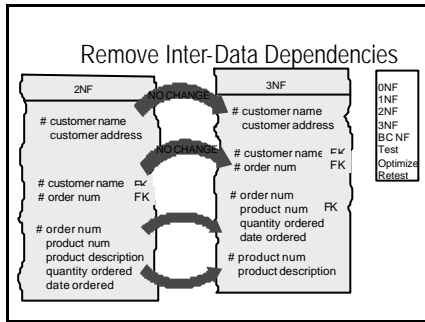
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Diapositiva  
98




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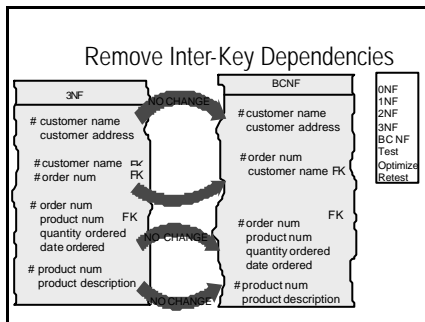
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Diapositiva  
99




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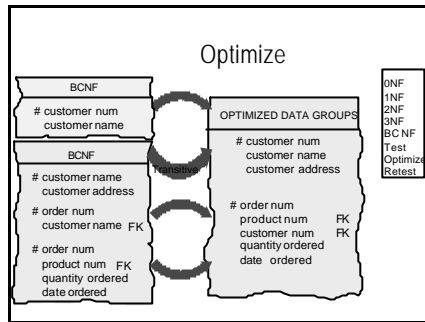
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Diapositiva  
100




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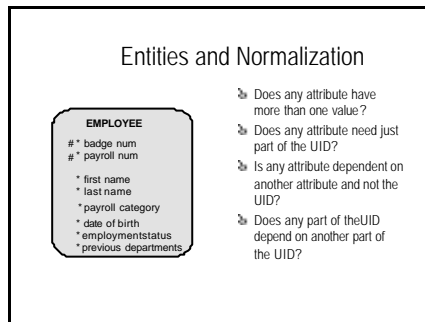
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Diapositiva  
101




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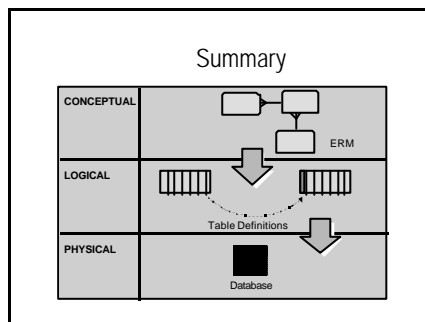
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Diapositiva  
102




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