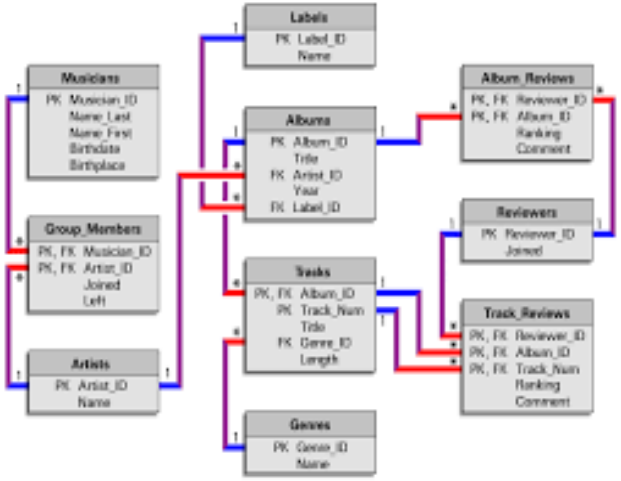
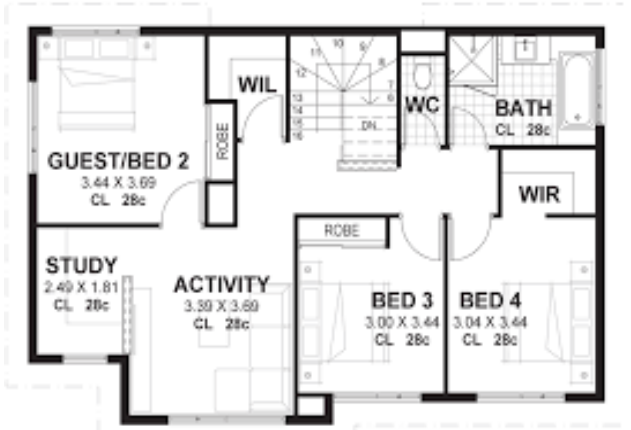
Database design





Database design

- All products are designed before made; a model is developed first
- A model represents a real object
- E.g a house plan, car model

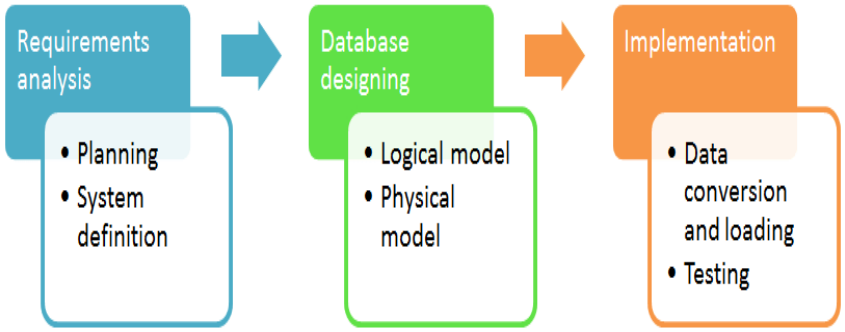
Database design

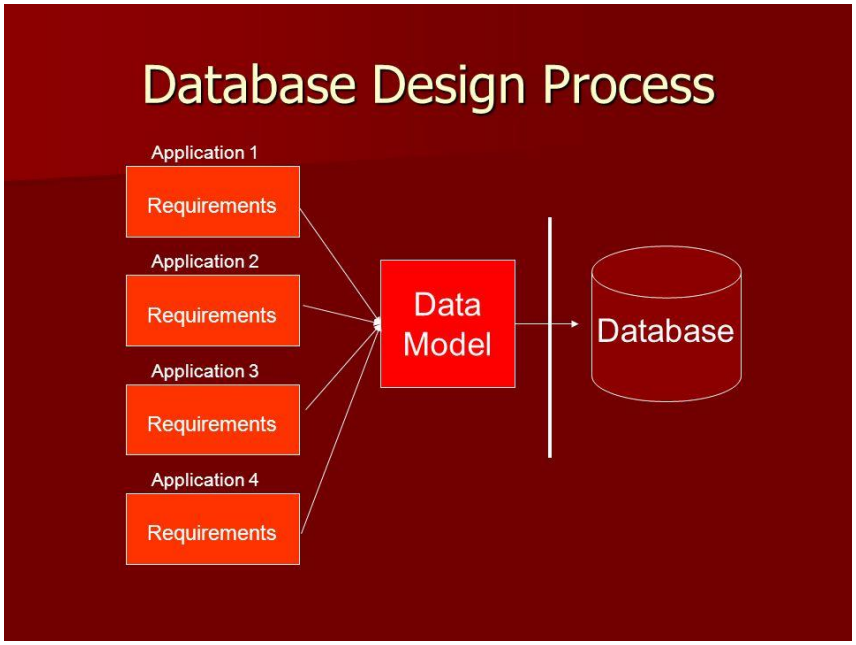
- Similarly, in database design, a model of a database is developed before the actual creation of the database
- This is refers to as a data model of a database
- A model imitates an original object

Database design

- A database model is refers to a prototype
- The data models are logical; they clearly and accurately depict data relationship based a certain agreed standards and practices in database designing

Database Design Steps/Approaches





Four steps in designing a database

1. Requirements analysis
2. Conceptual design
3. Logical design
4. Physical design

- In this lecture, we deal with the first two.

Step 1. Database requirements analysis

- This is the process of collecting and analyzing information about the organization that is to be supported by the database system
- Information collected help to identify the requirements for the database; it forms the basis for creating data model
- This vital for the successful implementation of a database

Database requirements analysis Cont…

- Collect information on among other things:

i. The names of entities you want to keep information on

Database design steps Cont.....

2. Conceptual design

- The next step is to create a conceptual schema/ model for the database using a high level conceptual data model using an Entity-Relationship (ER) diagram or Unified Modeling Language (UML) class diagram

Database design steps Cont.....

- This model describes how different entities (objects, items) relate to each other
- It also describes what attributes (features) each entity has

Database design steps Cont.....

a). Entity Relationship Model

- An entity is an object or a thing that has physical or conceptual existence
- Entities with physical existence are those that we can see with our eyes which include employee while entities with conceptual existence are things that we cannot feel, touch and see with our eyes such as library membership

Database design steps Cont.....

- Organizations keep information on these various entities by creating databases
- For example, a library will keep information on entities such as library users, library materials and circulation of library materials
- Entities of a given type are grouped into **entity class**

Database design steps Cont.....

- Entities have number of instances (meaning the number of times the entity appears in the database).
- This is what is referred to as entity instance
- If for example you enter 100 users of the library in the database, it implies that the entity class *library user* has 100 instances.

Database design steps Cont.....

- All entities whether with physical or conceptual existence have attributes
- Attributes are features that help to describe entities
- For example, the entity library user has attributes such as *first name, last name, user id number, address, e-mail**, and** phone #.*

Database design steps Cont.....

- All entities do have identifiers
- Identifiers are attributes that uniquely identify each and every entity instance
- It is an attribute which is not common to all the entity instances.
- For library user entity instances, the identifier could be the **user id number**

Database design steps Cont.....

- The term relationship refers to association that exist among entities
- The E-R model contains both **relationship classes** and **relationship instances**

Database design steps Cont.....

- All relationships are given names that describe the nature of the relationship.
- For example, a relationship called *Loan relationship* shows the relationship that exists between the library user and library material.
- The relationship can involve two or more entity classes

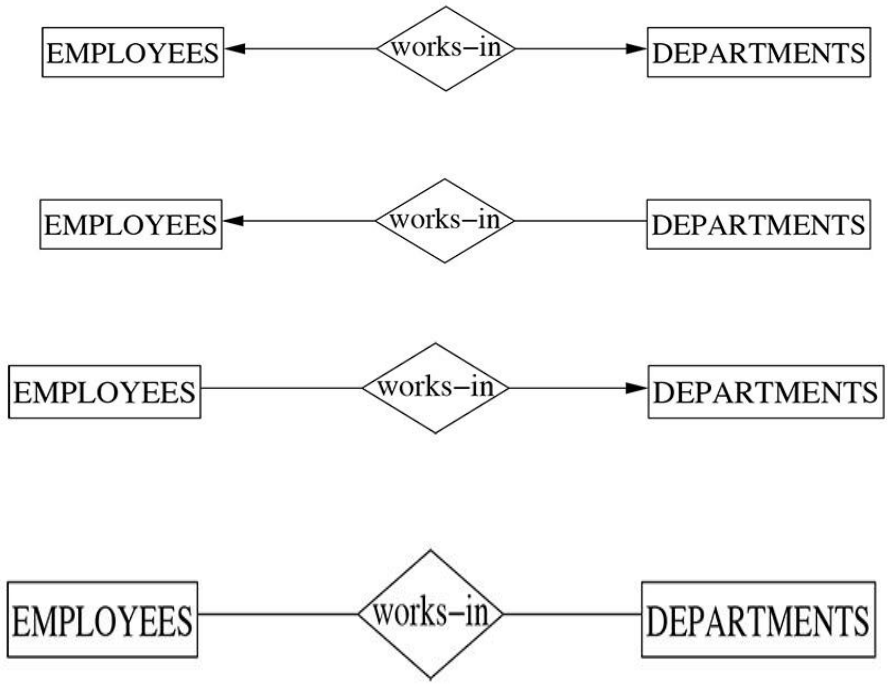
Database design steps Cont.....

- There are three (3) main types of relationships

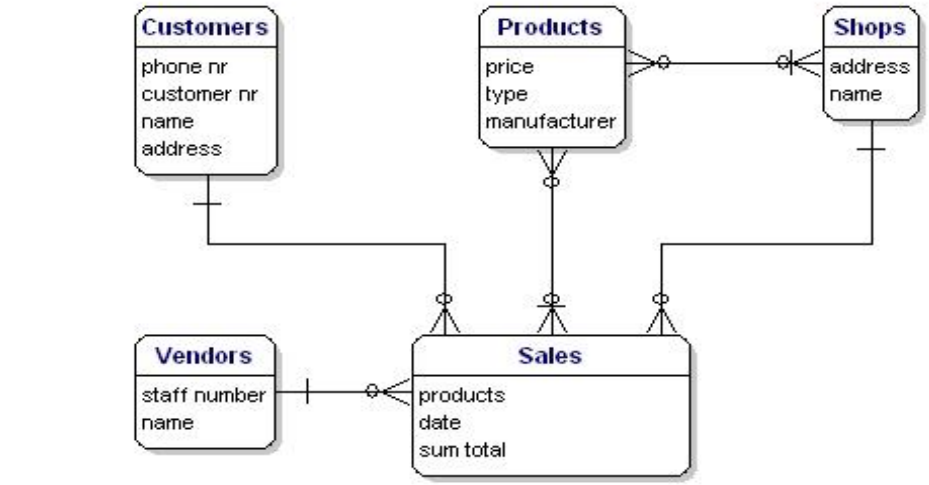
i) One-To-One

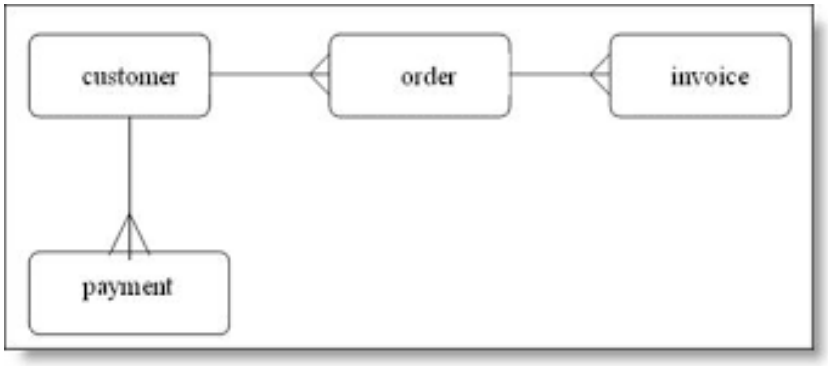
ii) One-To-Many

iii) Many-To-Many



Database design steps Cont.....





Database design steps Cont.....

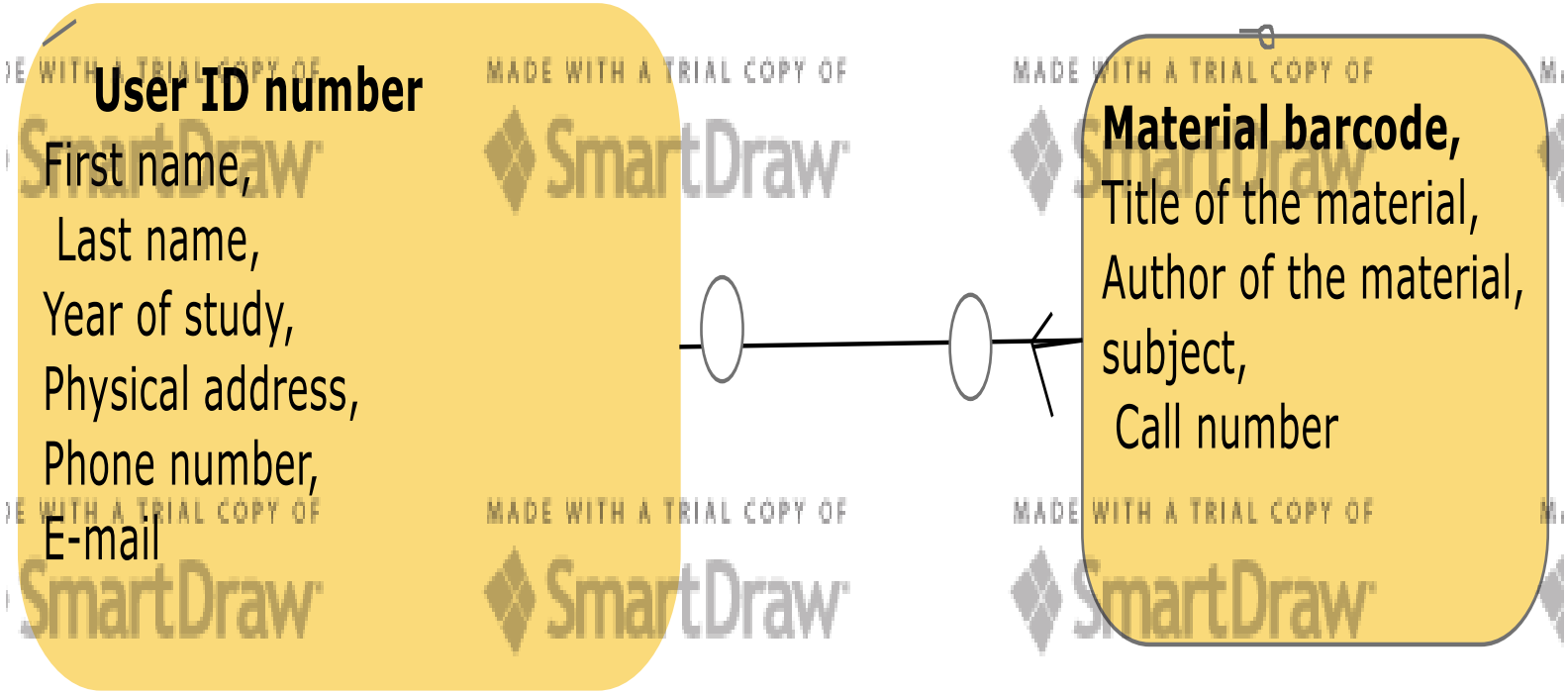
- The number of entity classes in a relationship is referred to as the **degree** of relationship.
- The *Loan relationship* above could be said to be a **degree of two**

Database design steps Cont.....

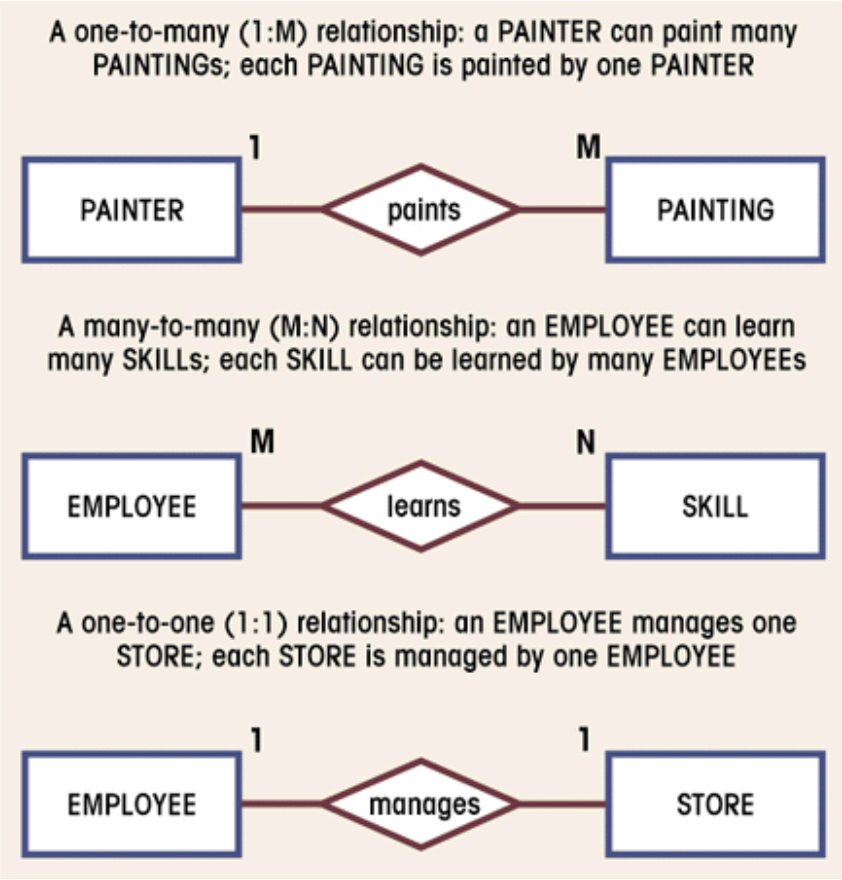
Logical design

- Relationships among entities are shown
- Further, attributes for each entity identified
- Among the attributes, primary and foreign keys are identified

Database design steps Cont.....

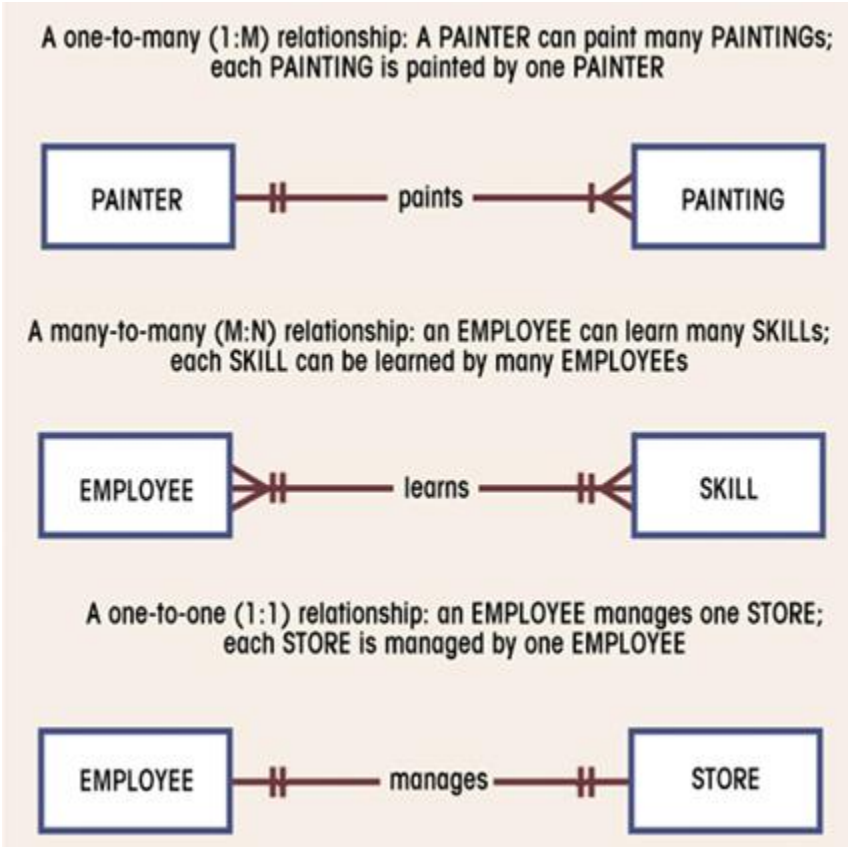


E-R Diagram: Chen Model

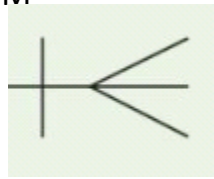


- Entity
  - represented by a rectangle with its name in capital letters.
- Relationships
  - represented by an active or passive verb inside the diamond that connects the related entities.
- Connectivities
  - i.e., types of relationship
  - written next to each entity box.

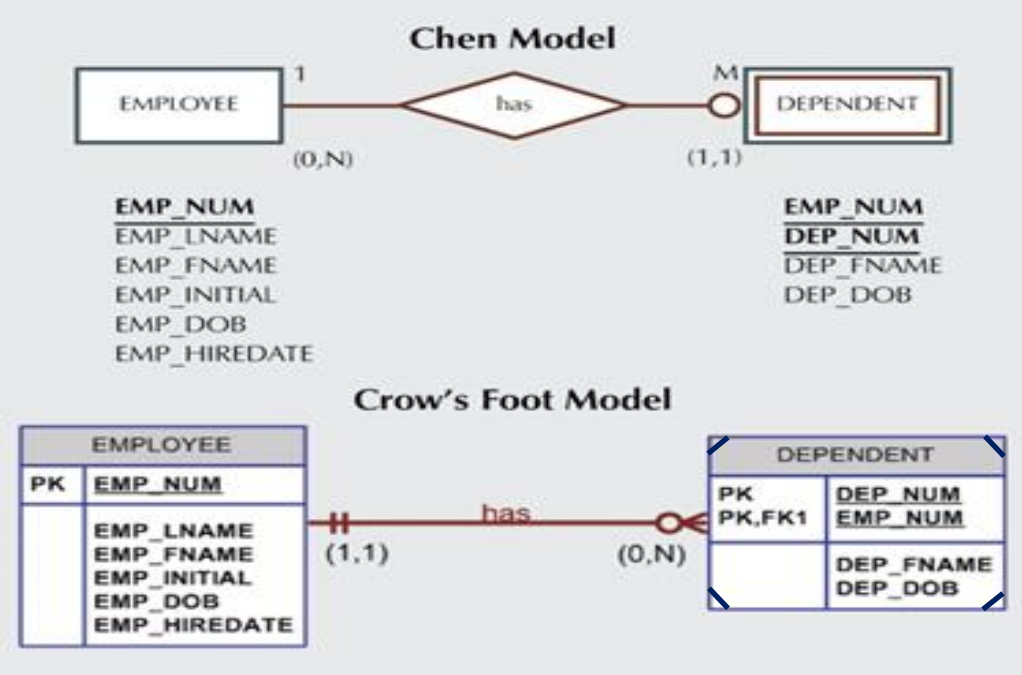
E-R Diagram: Crow's Foot Model



- Entity
  - represented by a rectangle with its name in capital letters.
- Relationships
  - represented by an active or passive verb that connects the related entities.
- Connectivities
  - indicated by symbols next to entities.
    - 2 vertical lines for 1
    - "crow's foot" for M
- It is good to use for many part



Relationship: Weak Entities



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Strong vs. Weak entities

- Strong Entity = existence-independent entity
- Weak Entity
  - ✓ existence-dependent entity in a strong relationship
  - ✓ inherits all or part of its primary key from parent entity
  - ✓ entity w/ clipped corners in CF model, double-walled in Chen model

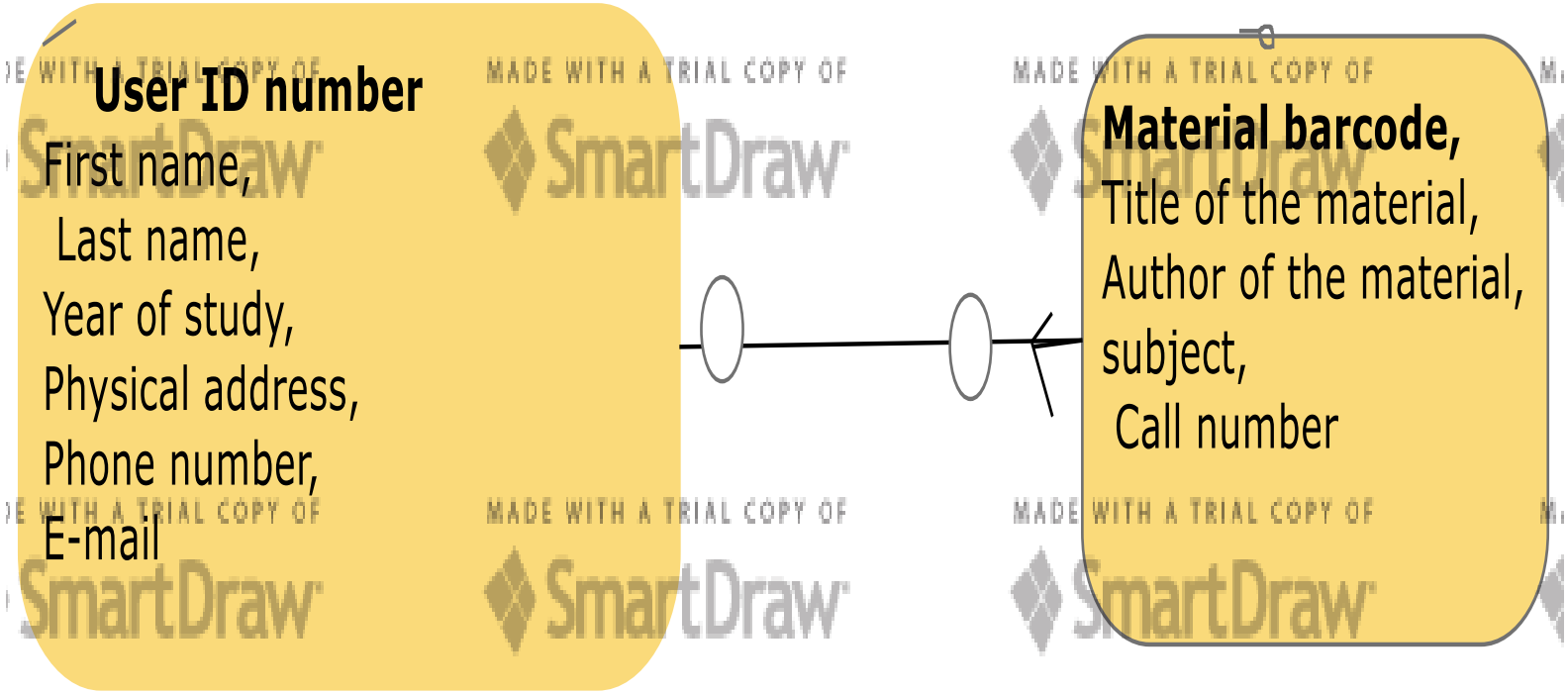
25

Database design steps Cont.....

Logical design

- Relationships among entities are shown
- Further, attributes for each entity identified
- Among the attributes, primary and foreign keys are identified

Database design steps Cont.....



Database design steps Cont.....

Normalization

- The goal of normalization is to eliminate redundancy and potential update anomalies
- **Five** normalization forms exist; first (1NF), second (2NF), third(3NF), fourth(4NF) and fifth (5NF) normal forms
- **Note** that database designers do not use all the five normal forms (3NF) is enough

Database design steps Cont.....

(a) First Normal Form (1NF)

- Ensure that no two or more rows contain repeating information
- Each column should therefore be unique thus creating unique rows
- 1NF advocates also that each row should have **a primary key**.
- No column should keep more than one value.

Database design steps Cont.....

Example

Un-normalized table

Title
Author
Edition
Place of publication
Publisher
ISBN

Database design steps Cont.....

After Normalization in NF1

Barcode
Author surname
Author given name
Title
Edition
Place of publication
Publisher
ISBN

Database design steps Cont.....

Second Normal Form (2NF)

- 2NF emphasizes that there should be no partial dependency of any column on a primary key.
- Means that all the columns (fields) should depend entirely on the primary key

Database design steps Cont.....

Second Normal Form (2NF)

- Author surname and given name are not entirely dependent on the primary key barcode
- Therefore, we need remove these fields and create another table called author

Database design steps Cont.....

Examples normalization in 2NF

Author ID
surname
Given name
Physical address
Phone no.
E-mail

Book ID
Title
Edition
Place of publication
Publisher
ISBN

Database design steps Cont.....

Third Normal Form (3NF)

- The table is said to be in 3NF if it meets the requirements of 2NF
- And that none- key attribute in the row does not depend on the entry in another column

Database design steps Cont.....

- In the above two tables, no column could be said to be dependent on another column for data entry
- However, in the book materials table, the column publisher with related columns such as place of publication do not depend on the primary key; need to remove them and create another table

Database design steps Cont.....

Author ID
surname
Given name
Physical address
Phone no.
E-mail

Publisher ID
Book ID
Author ID
Name
City
Physical address
Phone no.
E-mail

Book ID
Title
Edition
Place of publication
ISBN

Database design steps Cont.....

Physical design

- Decide on the number of tables to create for your database
- Number of tables is determined by the number of entities and types of relationships that exist among them
- Entities names should be translated into table names

Database design steps Cont.....

- Having decided on the number and name of tables, list all the possible attributes or fields (columns) of each table
- Determine also the data type for each field or column

Database design steps Cont.....

Tables in physical design stage

Publisher ID INT (4)
Name VACHAR (40)
City VARCHAR (20)
Physical address VARCHAR (50)
Phone no. CHAR (13)
E-mail VRACHAR (50)

Database design steps Cont.....

Feature	Conceptual	Logical	Physical
Entity Names	✓	✓	
Entity Relationships	✓	✓	
Attributes		✓	
Primary Keys		✓	✓
Foreign Keys		✓	✓
Table Names			✓
Column Names			✓
Column Data Types			✓

End of Database design