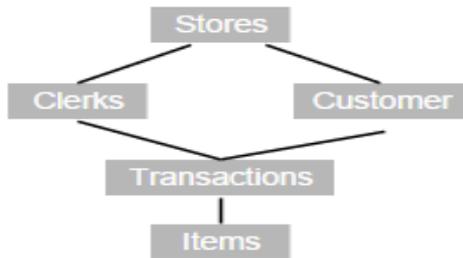


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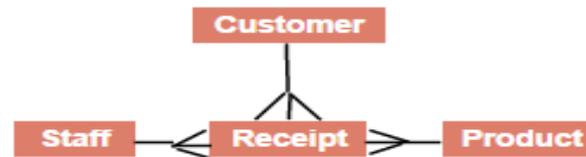
Part (3)

Data Models

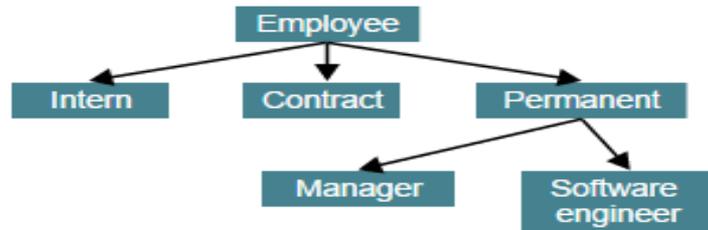
DBMS Models



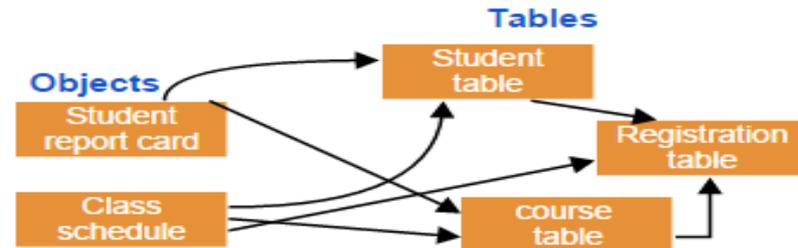
Network Database Model



Relational Database Model



Hierarchical Database Model



Object-oriented Database Model

Outlines of Part 3 use Chapter 5

- Hierarchical Model
- Network Model
- Relation Model
- Object Oriented Model

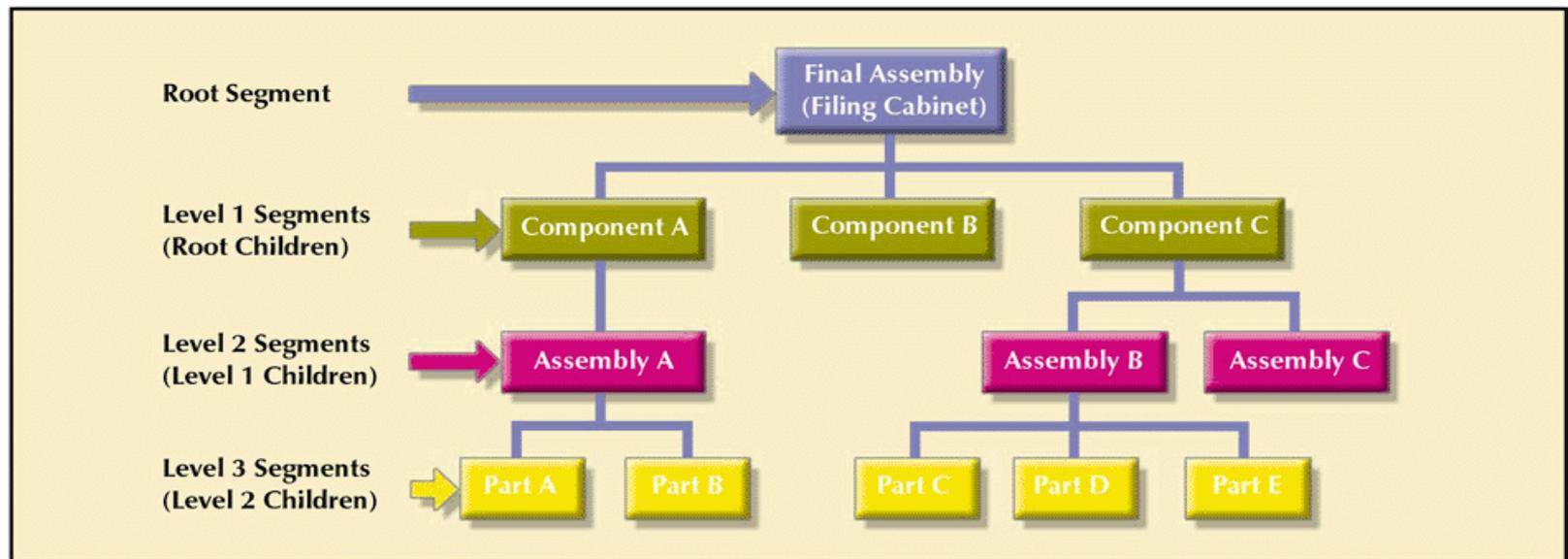
Data models – Introduction:



- Representational or implementation data models are the models used most frequently in traditional commercial DBMSs.
- These include the widely used **relational** data model, as well as the so-called legacy data models—**the network and hierarchical models**—
- We can regard the **object data model as an example of a new family of higher-level** (conceptual models) implementation data models that are closer to conceptual data models.
- A standard for object databases called the ODMG object model has been proposed by the Object Data Management Group (ODMG).

- Initially implemented in a joint effort by IBM and North American Rockwell around 1965. Resulted in the IMS family of systems.
- The hierarchical model is a restricted type of network model.
- **Data** is represented as collections of *records* and **relationships** are represented by *sets*.

FIGURE 2.1 A HIERARCHICAL STRUCTURE



Hierarchical Data Model(continued)

Example

- Figure 2.6 illustrates an instance of a hierarchical schema.

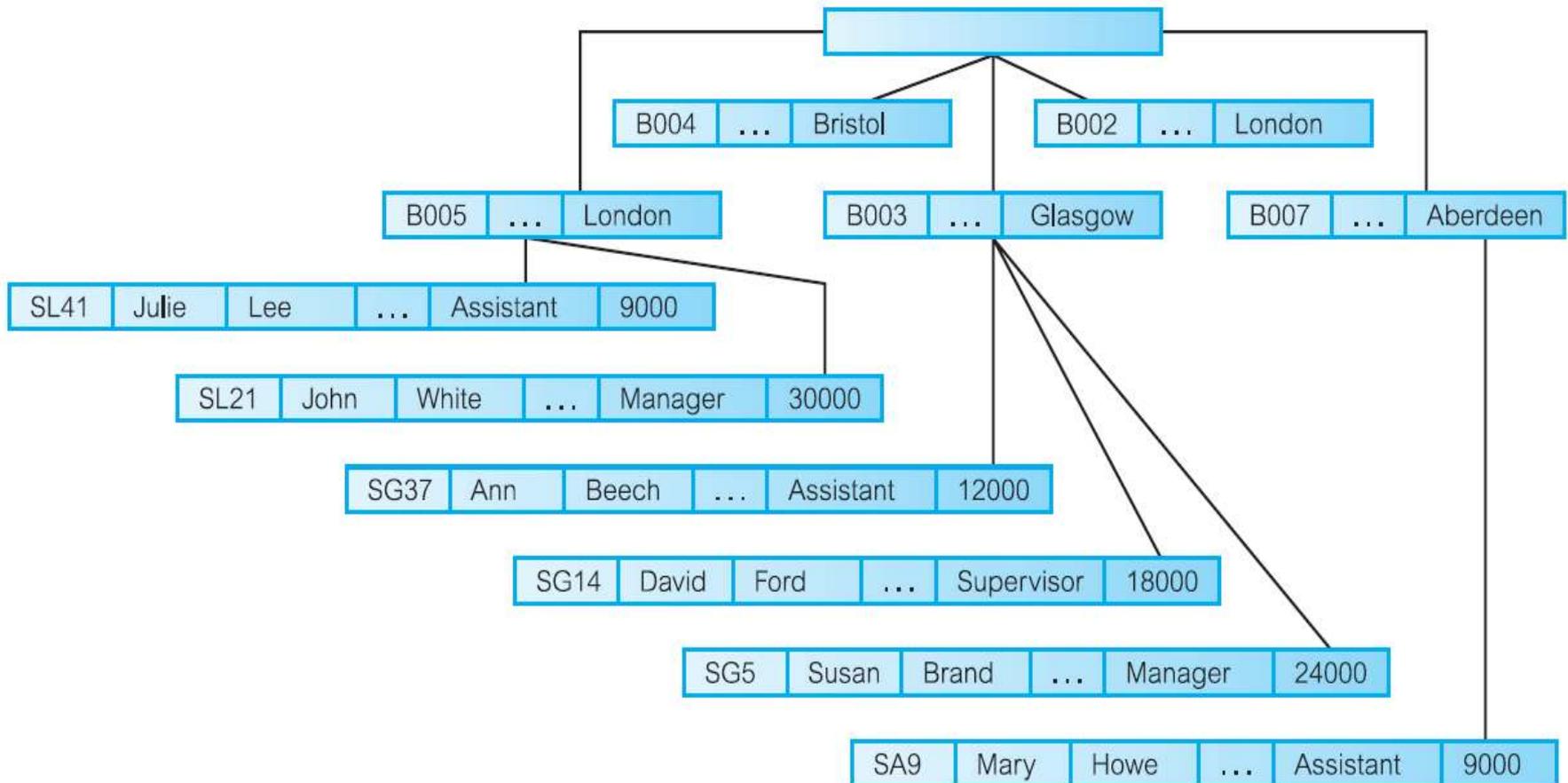


Figure 2.6 A sample instance of a hierarchical schema.

Characteristics

- Each parent can have many children
- Each child has only one parent
- Limitations lead to a different way of looking at database design
- Tree is defined by path that traces parent segments to child segments, beginning from the left Hierarchical path
- Preorder traversal or hierarchic sequence “Left-list” path

Advantages

- Conceptual simplicity – easy to understand the model layout
- Data independence (a change in a data type will be automatically cascaded throughout the database by the DBMS, thereby eliminating the need to make changes in the program segments that reference the changes data type)
- Database integrity – always a link between parent and child
- Efficiency – very efficient when it contains a large volume of data in 1:M relationships and whose relationships are fixed over time

Disadvantages

- Lacks structural independence
- Complex applications programming and use – programmers and end users must know precisely how the data are physically distributed within the database
- Implementation limitations – difficult to support M:N relationships
- Lack of standards – no standard DDL and no DML

■ In the network model, **data** is represented as collections of *records*, and **relationships** are represented by *sets*.

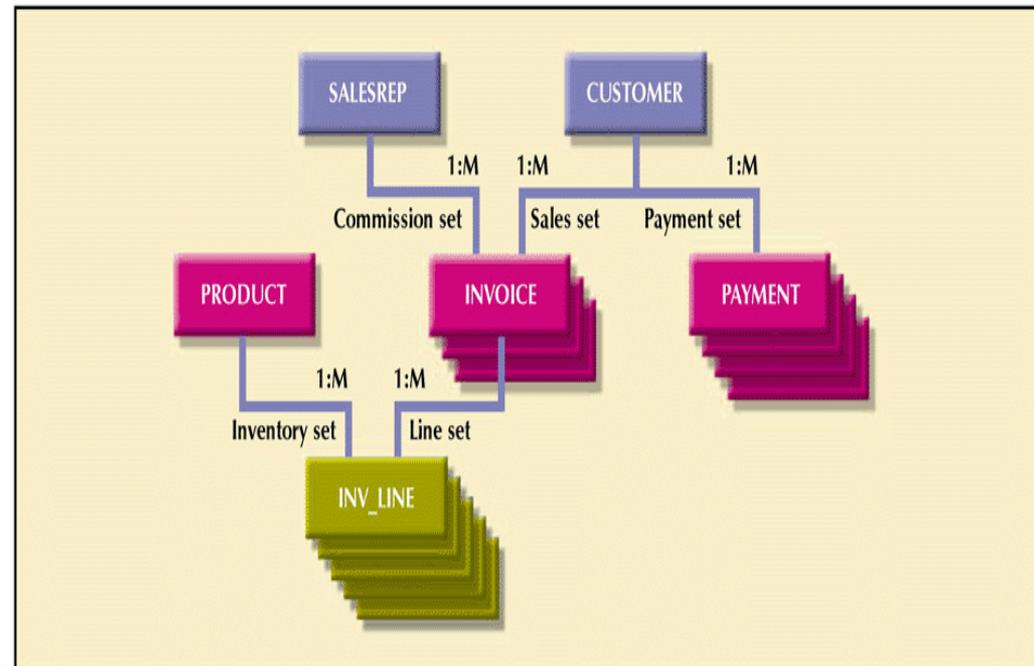
■ Created to

□ Represent complex data relationships more effectively

□ Improve database performance

□ Impose a database standard

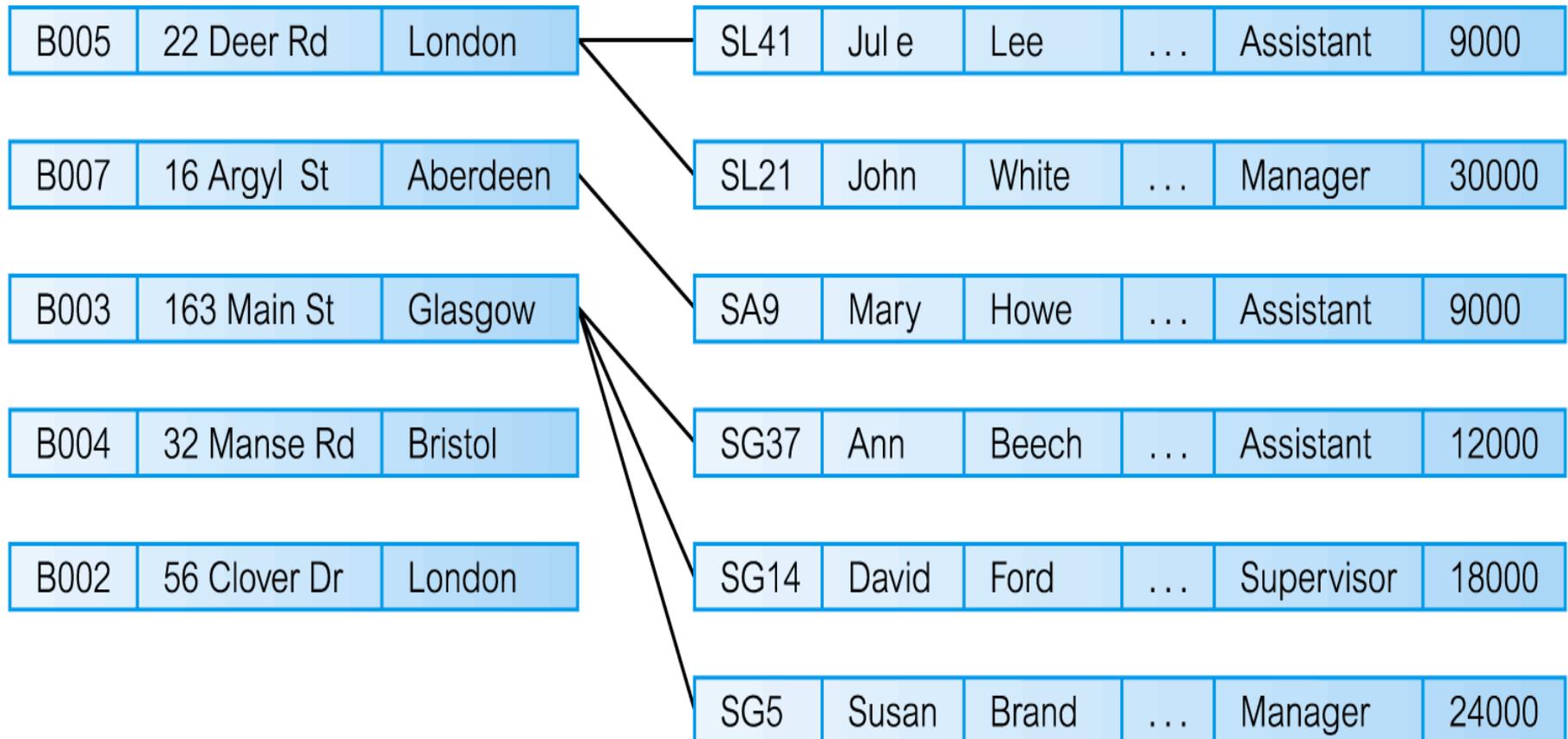
FIGURE 2.3 A NETWORK DATA MODEL



Network Data Model.....Cont- Example



Figure 2.5 illustrates an instance of a network schema for the same data set presented.



- ❑ Resembles hierarchical model
 - ❑ Collection of records in N:M (or 1:N) relationships (A relationship is called a Set)
 - ❑ Composed of at least two record types
 - Owner
 - Equivalent to the hierarchical model's parent
 - Member
 - Equivalent to the hierarchical model's child
- A record can appear as a member in more than one set i.e., a member may have multiple owners

Network Data Model.....Cont- Advantages



- Conceptual simplicity
- Handles more relationship types
- Data access flexibility – no need for a preorder traversal
- Promotes database integrity – must first define the owner and then the member record
- Data independence
- Conformance to standards (DDL & DML)

Network Data Model.....Cont-

Disadvantages



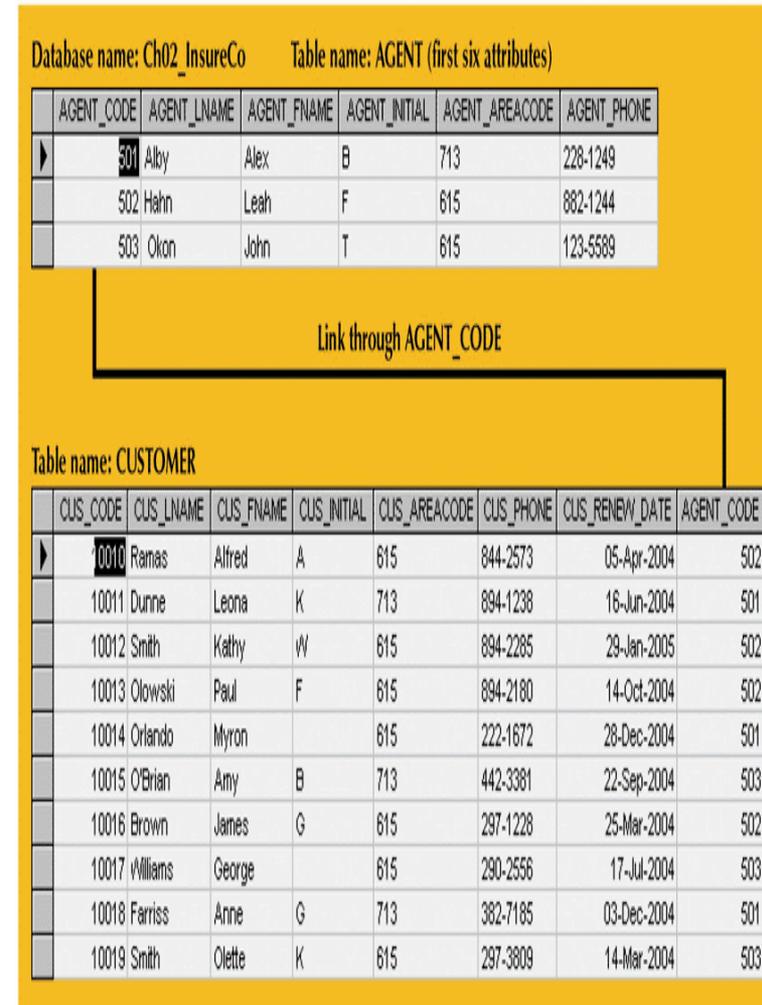
- System complexity
- Lack of structural independence

Relational Model:



- Proposed in 1970 by E.F. Codd (IBM), first commercial system in 1981-82.
- Conceptually simple
- Now in several commercial products (e.g. DB2, ORACLE, MS SQL Server, SYBASE, INFORMIX).
- Several free open source implementations, e.g. MySQL, PostgreSQL
- Currently most dominant for developing database applications.
- In the relational model, data and relationships are represented as tables, each of which has a number of columns with a unique name.

FIGURE 2.4 LINKING RELATIONAL TABLES



Relational ModelCont.:

The Relational Model:Basic Structure

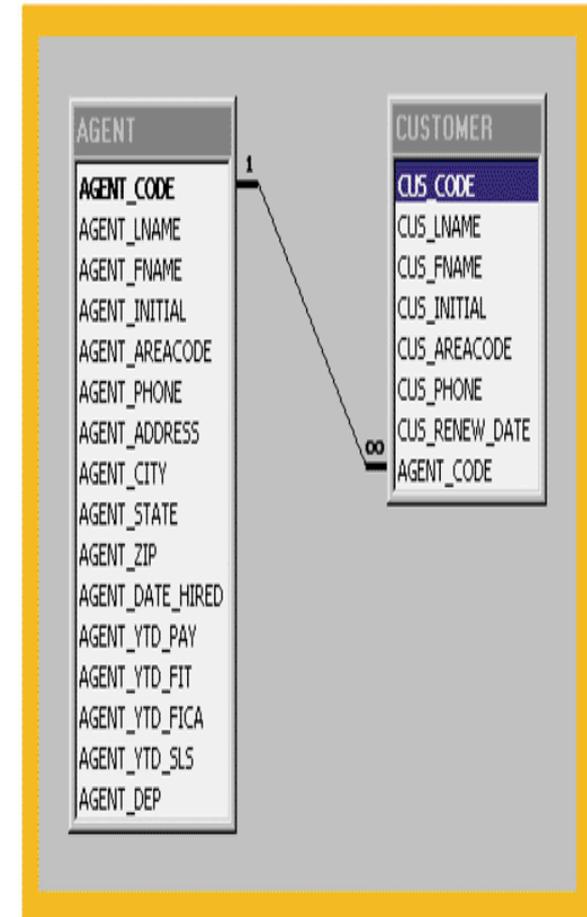
❖ Table (relations)

Matrix consisting of a series of row/column intersections Related to each other by sharing a common entity characteristic

❖ Relational schema

Visual representation of relational database's entities, attributes within those entities, and relationships between those entities

FIGURE 2.5 A RELATIONAL SCHEMA



Relational ModelCont.:

Example



Figure 2.4 is a sample instance of a relational schema for part of the *DreamHome case study*, showing *branch* and *staff* details.

For example, it shows that employee John White is a manager with a salary of £30,000, who works at branch (branchNo) B005, which, from the first table, is at 22 Deer Rd in London.

Branch

branchNo	street	city	postCode
B005	22 Deer Rd	London	SW1 4EH
B007	16 Argyll St	Aberdeen	AB2 3SU
B003	163 Main St	Glasgow	G11 9QX
B004	32 Manse Rd	Bristol	BS99 1NZ
B002	56 Clover Dr	London	NW10 6EU

Staff

staffNo	fName	IName	position	sex	DOB	salary	branchNo
SL21	John	White	Manager	M	1-Oct-45	30000	B005
SG37	Ann	Beech	Assistant	F	10-Nov-60	12000	B003
SG14	David	Ford	Supervisor	M	24-Mar-58	18000	B003
SA9	Mary	Howe	Assistant	F	19-Feb-70	9000	B007
SG5	Susan	Brand	Manager	F	3-Jun-40	24000	B003
SL41	Julie	Lee	Assistant	F	13-Jun-65	9000	B005

Advantages



- Most important advantage of the RDBMS is its ability to let the user/designer operate in a human logical environment
- Structural independence – changes in the relational data structure do not affect the DBMS's data access in any way
- Easier database design, implementation, management, and use
- Powerful database management system

Relational ModelCont.:

Disadvantages



- Significant hardware and system software overhead
- Can facilitate poor design and implementation
- Little scope for "query optimization"

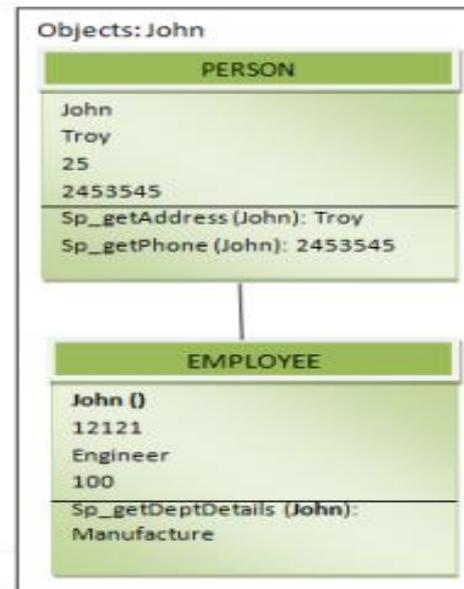
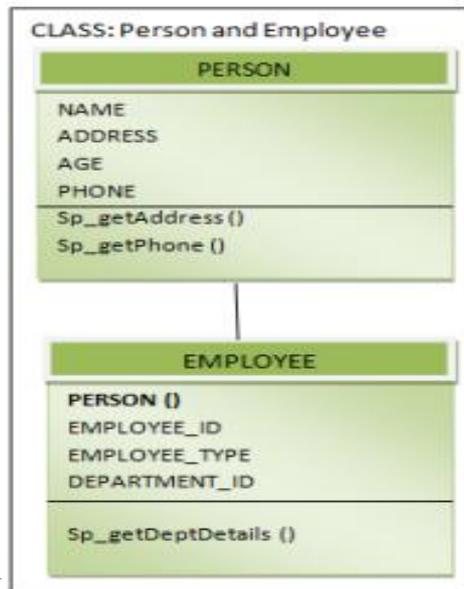
Object-oriented Data Models



- Semantic data model (SDM) developed by Hammer and McLeod in 1981
- Modeled both data and their relationships in a single structure known as an object
- Basis of object oriented data model (OODM)
- OODM becomes the basis for the object oriented database management system (OODBMS)
- One set comprises models of persistent O-O Programming Languages such as C++



- Object is described by its factual content
 - Like relational model's entity
- Includes information about relationships between facts within object and relationships with other objects
 - Unlike relational model's entity



Object-oriented Data Models:...Cont.

Developments that Boosted OODM's Popularity



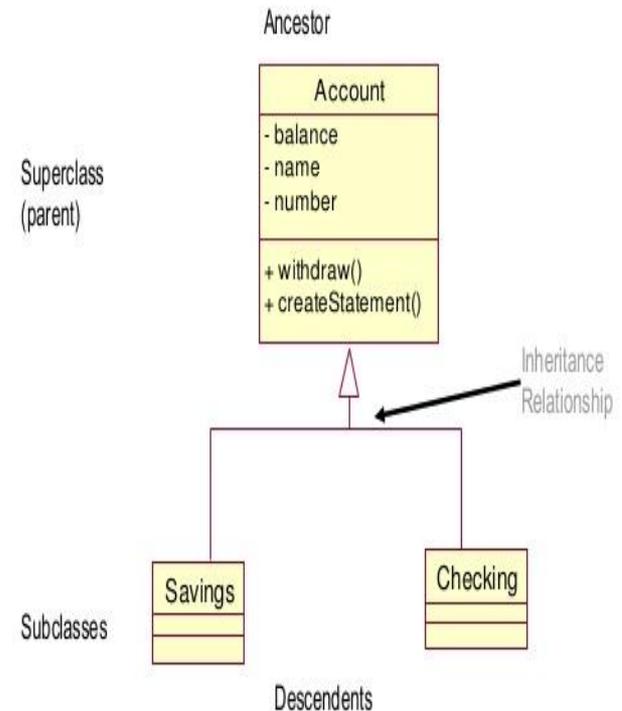
- Growing costs put a premium on code reusability.
- Complex data types and system requirements became difficult to manage with a traditional RDBMS.
- Became possible to support increasingly sophisticated transaction & information requirements.
- Ever-increasing computing power made it possible to support the large computing overhead required

Basic Structure

- Object: abstraction of a real-world entity
- Attributes describe the properties of an object
- Objects that share similar characteristics are grouped in classes
- Classes are organized in a class hierarchy
- Inheritance is the ability of an object within the class hierarchy to inherit the attributes and methods of classes above it

Example: Single Inheritance

One class inherits from another.



Object-oriented Data Models:...Cont.

Advantages



- Database integrity
- Both structural and data independence

- Steep learning curve
- High system overhead slows transactions
- Lack of market penetration

Thank you