Chapter 1

File Systems and Databases

Database Systems: Design, Implementation, and Management, Fifth Edition, Rob and Coronel

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In this chapter, you will learn:

- What a database is, what it does, and why database design is important
- How modern databases evolved from files and file systems
- About flaws in file system data management
- What a DBMS is, what it does, and how it fits into the database system
- About types of database systems and database models

Introducing the Database

- **Data versus Information**
  - **Data constitute building blocks of information**
  - **Information produced by processing data**
  - **Information reveals meaning of data**
  - **Good, timely, relevant information key to decision making**
  - **Good decision making key to organizational survival**

Database Management

- **Database is shared, integrated computer structure housing:**
  - **End user data**
  - **Metadata**
- **Database Management System (DBMS)**
  - **Manages Database structure**
  - **Controls access to data**
  - **Contains query language**

Importance of DBMS

- **Makes data management more efficient and effective**
- **Query language allows quick answers to *ad hoc* queries**
- **Provides better access to more and better-managed data**
- **Promotes integrated view of organization's operations**
- **Reduces the probability of inconsistent data**

DBMS Manages Interaction

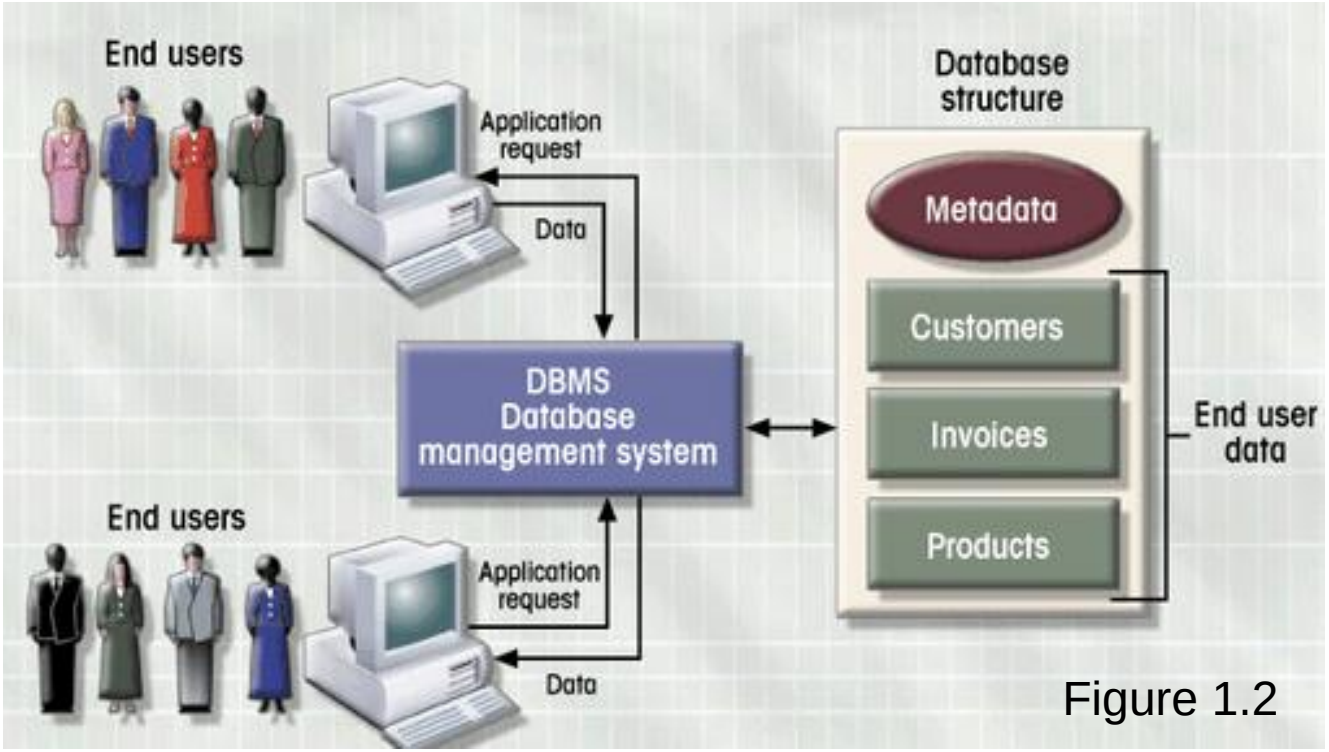


Figure 1.2

Database Design

- **Importance of Good Design**
  - **Poor design results in unwanted data redundancy**
  - **Poor design generates errors leading to bad decisions**
- **Practical Approach**
  - **Focus on principles and concepts of database design**
  - **Importance of logical design**

Historical Roots of Database

- First applications focused on clerical tasks
- Requests for information quickly followed
- File systems developed to address needs
  - Data organized according to expected use
  - Data Processing (DP) specialists computerized manual file systems

File Terminology

- Data
  - Raw Facts
- Field
  - Group of characters with specific meaning
- Record
  - Logically connected fields that describe a person, place, or thing
- File
  - Collection of related records

Simple File System

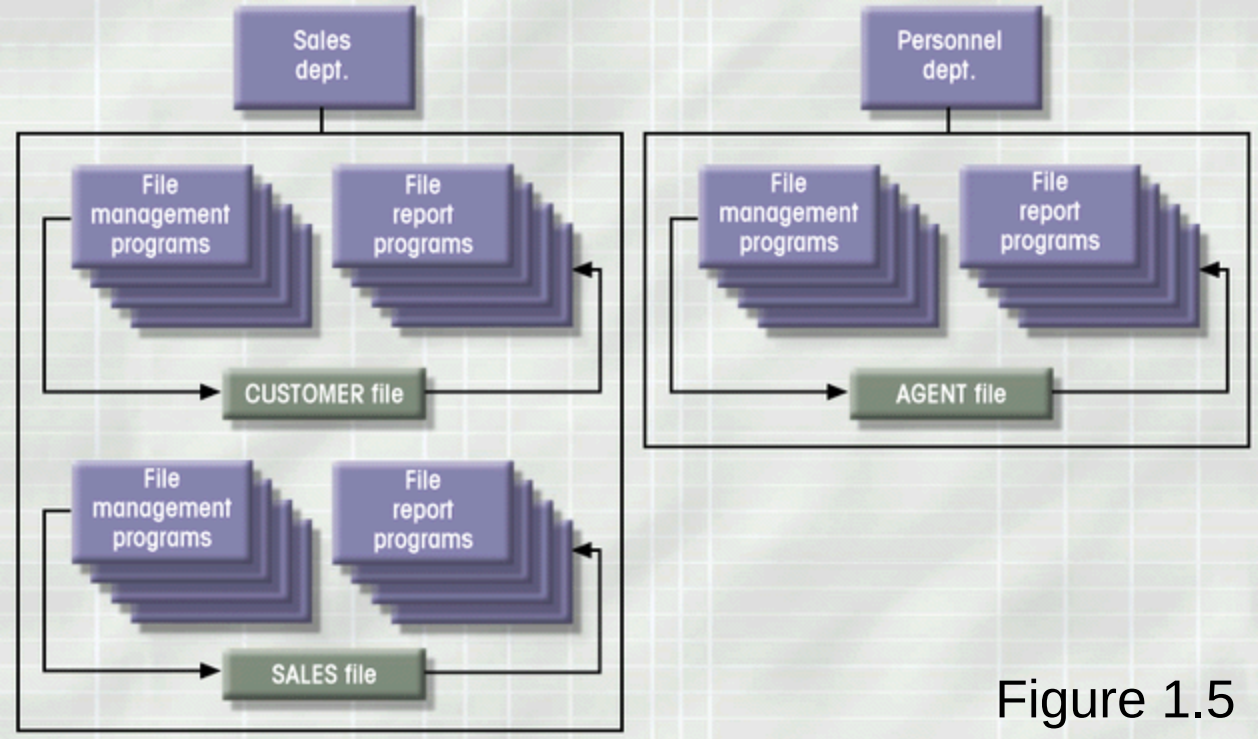


Figure 1.5

File System Critique

- **File System Data Management**
  - **Requires extensive programming in third-generation language (3GL)**
  - **Time consuming**
  - **Makes ad hoc queries impossible**
  - **Leads to islands of information**

File System Critique (con't.)

- **Data Dependence**
  - **Change in file's data characteristics requires modification of data access programs**
  - **Must tell program what to do and how**
  - **Makes file systems cumbersome from programming and data management views**
- **Structural Dependence**
  - **Change in file structure requires modification of related programs**

File System Critique (con't.)

- **Field Definitions and Naming Conventions**
  - **Flexible record definition anticipates reporting requirements**
  - **Selection of proper field names important**
  - **Attention to length of field names**
  - **Use of unique record identifiers**

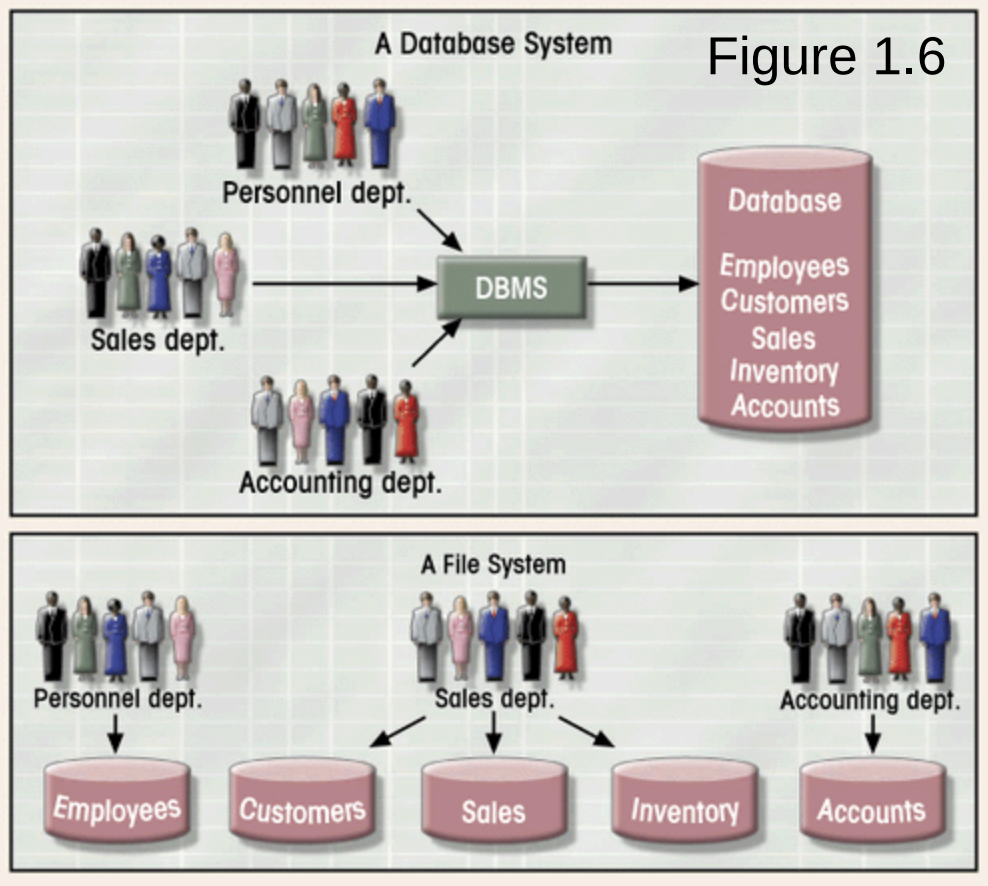
File System Critique (con't.)

- Data Redundancy
  - Different and conflicting versions of same data
  - Results of uncontrolled data redundancy
    - Data anomalies
      - Modification
      - Insertion
      - Deletion
    - Data inconsistency
      - Lack of data integrity

Database Systems

- Database consists of logically related data stored in a single repository
- Provides advantages over file system management approach
  - Eliminates inconsistency, data anomalies, data dependency, and structural dependency problems
  - Stores data structures, relationships, and access paths

Database vs. File Systems



Database System Environment

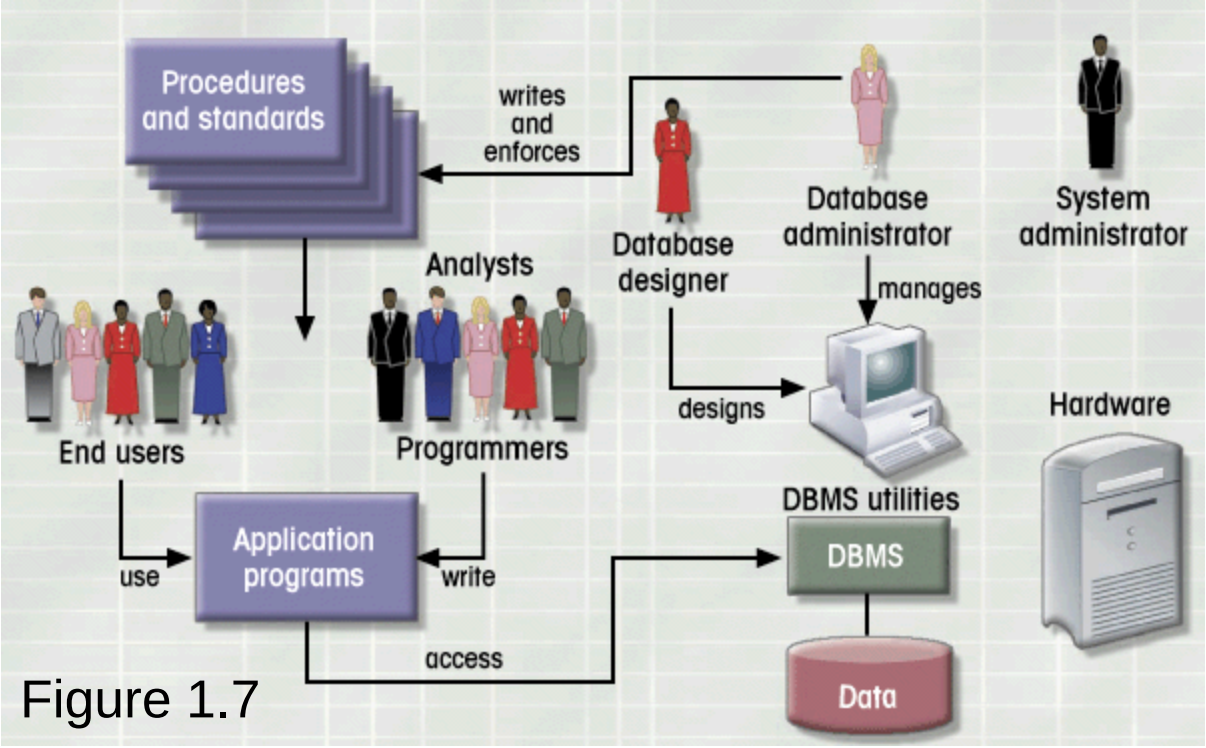


Figure 1.7

Database System Types

- Single-user vs. Multiuser Database
  - Desktop
  - Workgroup
  - Enterprise
- Centralized vs. Distributed
- Use
  - Production or transactional
  - Decision support or data warehouse

DBMS Functions

- Data dictionary management
- Data storage management
- Data transformation and presentation
- Security management
- Multiuser access control
- Backup and recovery management
- Data integrity management
- Database language and application programming interfaces
- Database communication interfaces

Database Models

- **Collection of logical constructs used to represent data structure and relationships within the database**
  - **Conceptual models: logical nature of data representation**
  - **Implementation models: emphasis on how the data are represented in the database**

Database Models (con't.)

- Relationships in Conceptual Models
  - One-to-one (1:1)
  - One-to-many (1:M)
  - Many-to-many (M:N)
- Implementation Database Models
  - Hierarchical
  - Network
  - Relational

Hierarchical Database Model

- **Logically represented by an upside down tree**
  - **Each parent can have many children**
  - **Each child has only one parent**

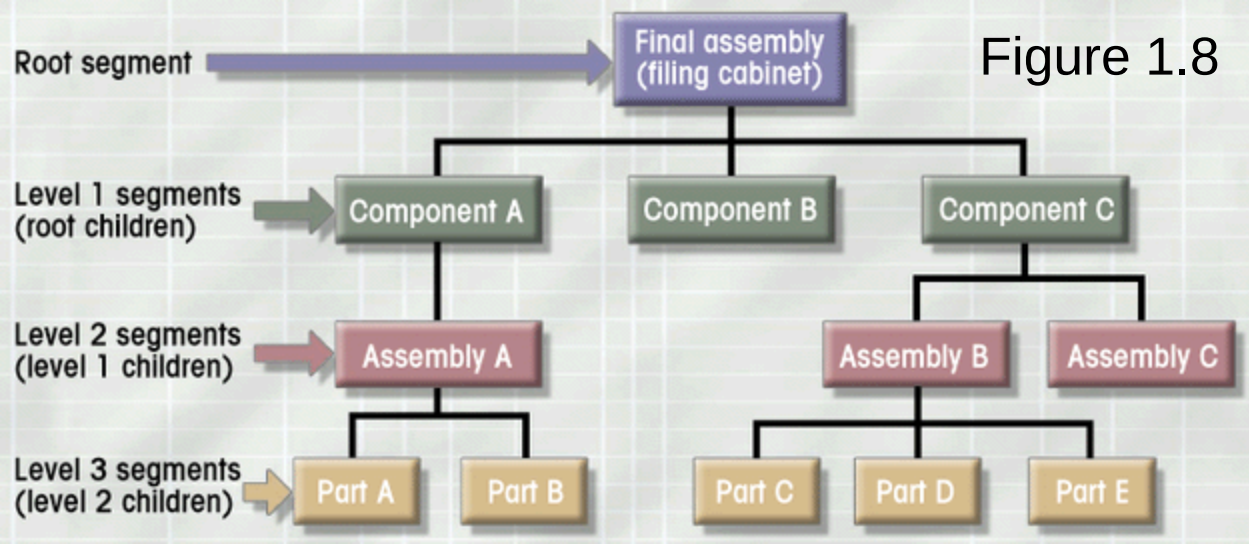


Figure 1.8

Hierarchical Database Model

- Advantages
  - Conceptual simplicity
  - Database security and integrity
  - Data independence
  - Efficiency
- Disadvantages
  - Complex implementation
  - Difficult to manage and lack of standards
  - Lacks structural independence
  - Applications programming and use complexity
  - Implementation limitations

Network Database Model

- Each record can have multiple parents
  - Composed of sets
  - Each set has owner record and member record
  - Member may have several owners

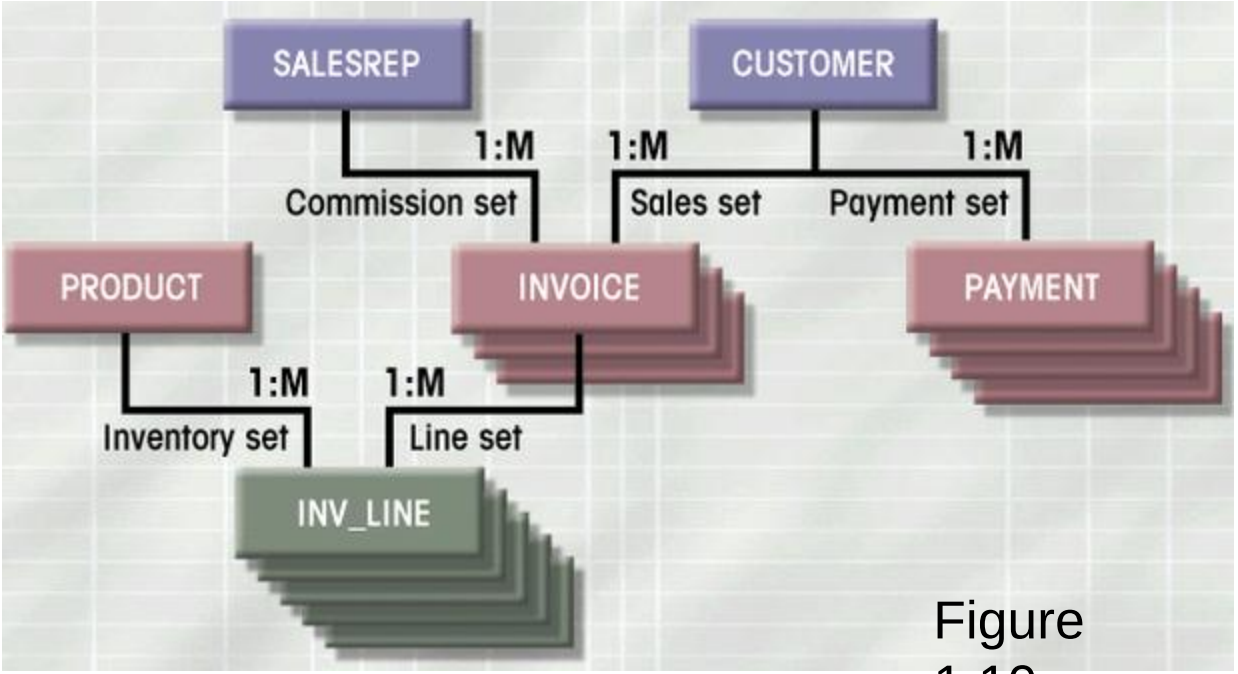


Figure 1.10

Network Database Model

- Advantages
  - Conceptual simplicity
  - Handles more relationship types
  - Data access flexibility
  - Promotes database integrity
  - Data independence
  - Conformance to standards
- Disadvantages
  - System complexity
  - Lack of structural independence

Relational Database Model

- Perceived by user as a collection of tables for data storage
- Tables are a series of row/column intersections
- Tables related by sharing common entity characteristic(s)

Relational Database Model (con't.)

Table name: AGENT

AGENT_CODE	AGENT_LNAME	AGENT_FNAME	AGENT_INITIAL	AGENT_AREACODE	AGENT_PHONE
501	Alby	Alex	B	713	228-1249
502	Hahn	Leah	F	615	882-1244
503	Okon	John	T	615	123-5589

Link through AGENT code

Figure 1.11

Table name: CUSTOMER

CUS_CODE	CUS_LNAME	CUS_FNAME	CUS_INITIAL	CUS_AREACODE	CUS_PHONE	CUS_RENEW_DATE	AGENT_CODE
10010	Ramas	Alfred	A	615	844-2573	05-Apr-2002	502
10011	Dunne	Leona	K	713	894-1238	16-Jun-2002	501
10012	Smith	Kathy	W	615	894-2285	29-Jan-2001	502
10013	Olowski	Paul	F	615	894-2180	14-Oct-2002	502
10014	Orlando	Myron		615	222-1672	28-Dec-2002	501
10015	O'Brian	Amy	B	713	442-3381	22-Sep-2002	503
10016	Brown	James	G	615	297-1228	25-Mar-2002	502
10017	Williams	George		615	290-2556	17-Jul-2002	503
10018	Farriss	Anne	G	713	382-7185	03-Dec-2002	501
10019	Smith	Olette	K	615	297-3809	14-Mar-2002	503

Relational Database Model

- **Advantages**
  - **Structural independence**
  - **Improved conceptual simplicity**
  - **Easier database design, implementation, management, and use**
  - **Ad hoc query capability with SQL**
  - **Powerful database management system**

Relational Database Model

- **Disadvantages**
  - **Substantial hardware and system software overhead**
  - **Poor design and implementation is made easy**
  - **May promote "islands of information" problems**

Entity Relationship Database Model

- Complements the relational data model concepts
- Represented in an entity relationship diagram (ERD)
- Based on entities, attributes, and relationships

Figure 1.13

Entity Relationship Database Model

- **Advantages**
  - **Exceptional conceptual simplicity**
  - **Visual representation**
  - **Effective communication tool**
  - **Integrated with the relational database model**
- **Disadvantages**
  - **Limited constraint representation**
  - **Limited relationship representation**
  - **No data manipulation language**
  - **Loss of information content**

Object-Oriented Database Model

- Objects or abstractions of real-world entities are stored
  - Attributes describe properties
  - Collection of similar objects is a class
    - Methods represent real world actions of classes
    - Classes are organized in a class hierarchy
  - Inheritance is ability of object to inherit attributes and methods of classes above it

Comparison of OO and E-R Data Models

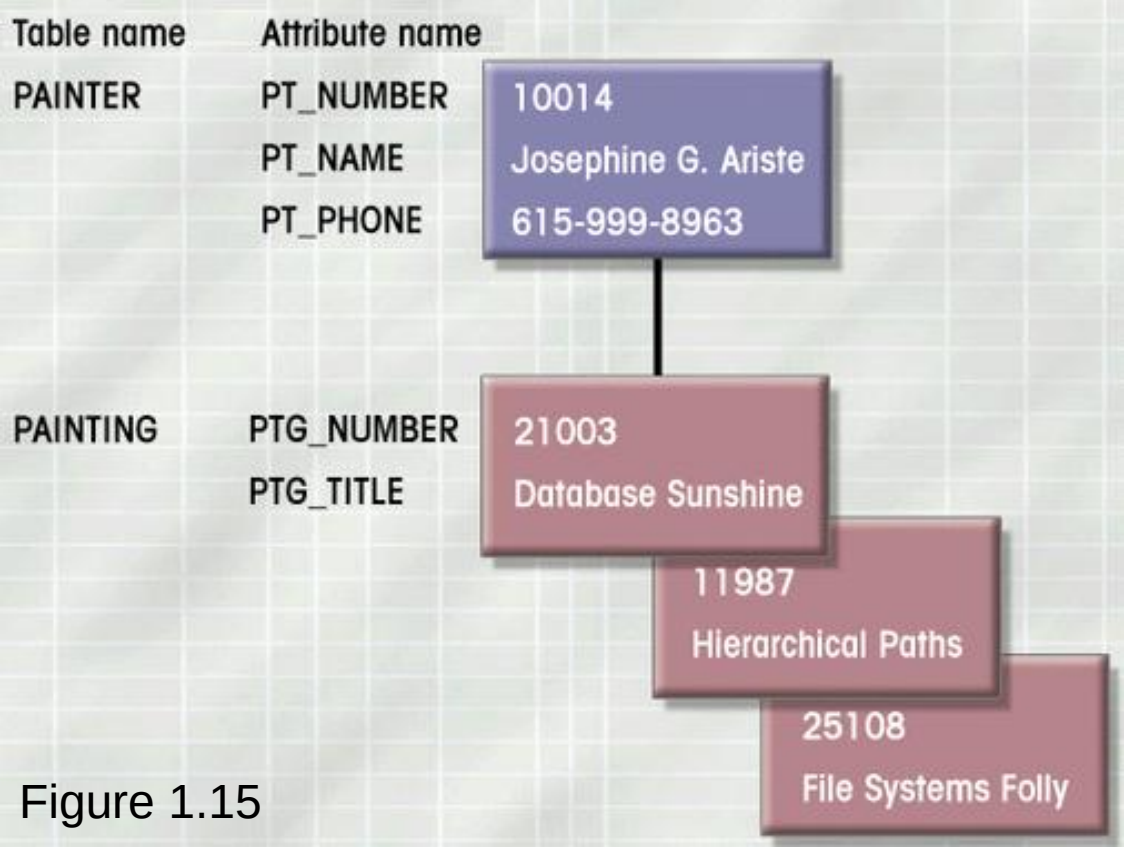


Figure 1.15

OO Data Model

- **Advantages**
  - **Adds semantic content**
  - **Visual presentation includes semantic content**
  - **Database integrity**
  - **Both structural and data independence**
- **Disadvantages**
  - **Lack of OODM**
  - **Complex navigational data access**
  - **Steep learning curve**
  - **High system overhead slows transactions**

Development of Data Models

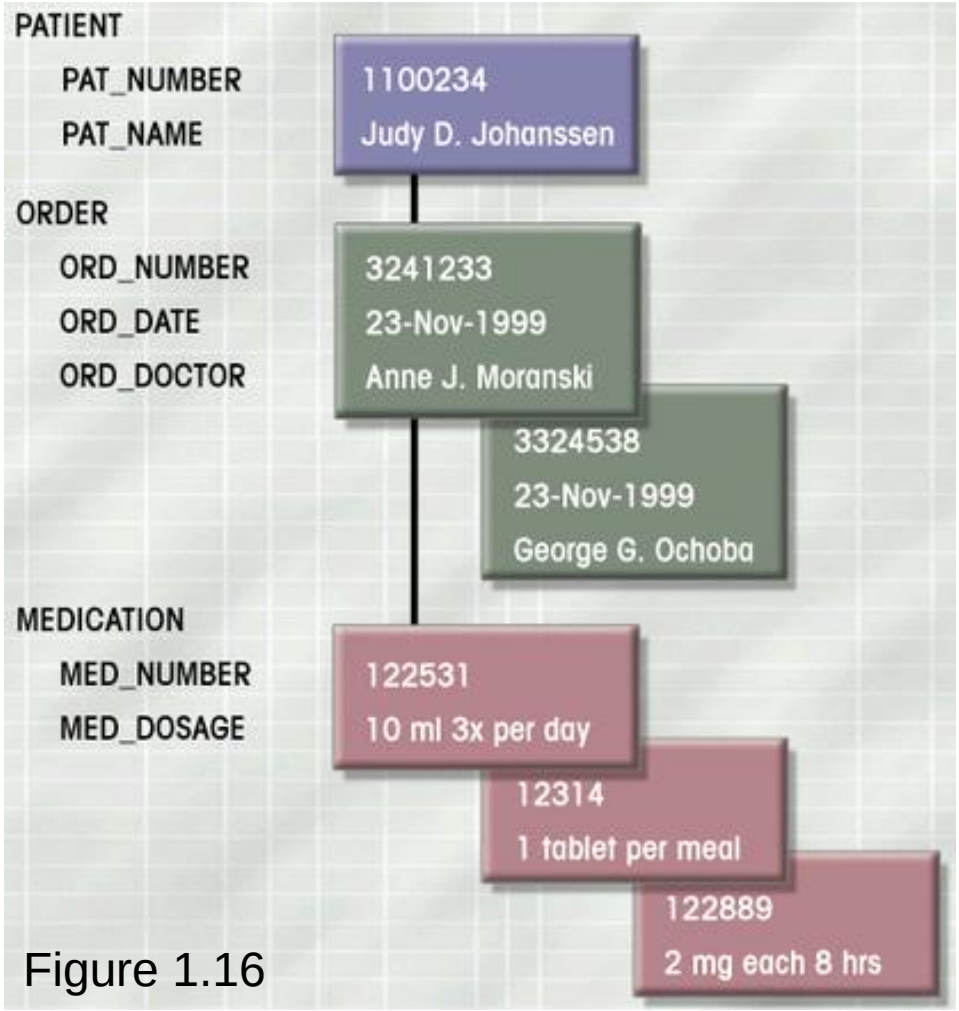


Figure 1.16

Database Models and the Internet

- **Characteristics of "Internet age" databases**
  - **Flexible, efficient, and secure Internet access**
  - **Easily used, developed, and supported**
  - **Supports complex data types and relationships**
  - **Seamless interfaces with multiple data sources and structures**
  - **Simplicity of conceptual database model**
  - **Many database design, implementation, and application development tools**
  - **Powerful DBMS GUI make DBA job easier**

Thank for your pay attention