

Databases Illuminated

Chapter One

Introductory Database Concepts

Uses of Databases

- Used in large and small organizations. Examples
 - Consumer websites—ordering products
 - Customer service websites – e.g. utility, health insurance, telephone service providers
 - Online banking
 - Credit card companies
 - Supermarkets and retail stores, including inventory control systems
 - Airline reservations
 - Medical records and billing
 - Employment records
 - School records
 - Bibliographic databases

A Sample Database

- Simple University database
- Need to keep information about
 - Students
 - Classes
 - Professors
 - Enrollment-links students to their classes
- Example uses Microsoft Access
- Data represented as **tables**
- Each row of Student table represents one student
- Each row of Class table represents one class
- Each row of Enroll represents **relationship** between one student and one class

See Figure 1.1

Query Tool

- Microsoft Access has a simple tool for forming and executing queries
- Query: Find the names of all students enrolled in ART103A
- Need to use Enroll table and Student table, since Enroll does not have names
- **Figure 1.2** shows query result

Reporting Tool

- Microsoft Access has a report generator
- Example: Print a report showing each class number, the ID and name of the faculty member teaching the class, and the IDs and names of all the students in that class
- **Figure 1.3** shows the report

The Integrated Database Environment

- **Database**
 - Large repository of data
 - Shared resource, used by many departments and applications
 - Contains several different record types
 - “knows” about relationships in data
 - Managed by database administrator - DBA
- **DBMS, Database Management System**
 - Controls access to database
 - Has facilities to
 - Set up database structure
 - Load the data
 - Retrieve requested data and format it for users
 - Hide sensitive data
 - Accept and perform updates
 - Handle concurrency
 - Perform backup and recovery ... and many other functions...
- **Users**
- **Applications**

Example of Integrated Database Environment

- See **Figure 1.4**
 - University database
 - DBMS - may be Access, Oracle, DB2,...
 - Users may be individuals on workstations (interactive users) or application programs
 - Both users and applications go through DBMS
 - Applications produce standard output, such as reports

People in Integrated Database Environment

- End users
 - **Casual users** use query language
 - **Naïve users** use programs
 - **Secondary users** use database output
- Applications programmers – write programs for other users
- Database administrator (DBA) – designs, creates, maintains the database
- **See Figure 1.5**

Advantages of Integrated Databases

- Compared with file systems, database can provide
 - Sharing of data
 - Control of redundancy
 - Data consistency
 - Improved data standards
 - Better data security
 - Improved data integrity
 - Balancing of conflicting requirements
 - Faster development of new applications
 - Better data accessibility
 - Economy of scale
 - More control of concurrency
 - Better backup and recovery procedures

Disadvantages of Databases

- Compared with file systems, databases have some disadvantages
 - High cost of DBMS
 - Higher hardware costs
 - Higher programming costs
 - High conversion costs
 - Slower processing of some applications
 - Increased vulnerability
 - More difficult recovery

Brief History of Information Systems -1

- Early human records-clay tablets, hieroglyphics, cave paintings, paper records of family histories, treaties, inventories, and so on
- Hollerith used **punched cards** in 1890 US census
- **Punched paper tape** introduced in 1940s
- **Magnetic tape** introduced about 1950-used in UNIVAC I
- Cards, paper tape, magnetic tape are **sequential access devices**
- Used in sequential processing applications such as payroll, shown in **Figure 1.6**
- **Batch processing** uses master file and transaction file as input; produces new master file as output

Brief History of Information Systems - 2

- Magnetic disk introduced in 1950s - **direct access device**
- Programming languages COBOL and PL/1 developed in 1960s
- Early database models developed
- Hierarchical model
 - IBM IMS developed for Apollo moon landing project
 - IMS product released in 1968
 - Most popular pre-relational DBMS
 - SABRE airline reservation system used IMS
- Network model
 - GE IDS developed by Charles Bachman in early 1960s
 - CODASYL DBTG proposed standards published in 1971
 - ANSI rejected proposal
 - New standards published in 1973, 1978, 1981 and 1984
 - Provided standard terminology, notion of layered database architecture

Brief History of Information Systems-3

- Relational model
 - Proposed by E.F. Codd in 1970 paper, "A Relational Model of Data for Large Shared Data Banks"
 - Strong theoretical foundation
 - System R, late 1970s
 - IBM's prototype relational system
 - Introduced SQL, Structured Query Language, now standard language
 - Peterlee Relational Test Vehicle at IBM UK Scientific Laboratory
 - INGRES at University of California, Berkeley
 - ORACLE used some System R results
 - Early microcomputer relational DBMSs :dBase, R:Base, Foxpro, Paradox
 - Microsoft Access most popular microcomputer-based DBMS
 - Oracle, DB2, Informix, Sybase, and Microsoft's SQL Server most popular enterprise DBMSs

Brief History of Information Systems-4

- Entity Relationship model
 - P.P. Chen, 1976
 - Semantic model – tries to capture meaning
- Object-oriented model
 - Can handle complex data
 - Introduced in 1990s
- Object-relational model: object-oriented capabilities added to relational databases
- Data warehouses developed in 1990s
 - Take data from many sources
 - May store historical data
 - Used for **data mining**, finding trends in data
- Internet provides access to vast network of databases
 - E-commerce
 - Wireless computing
 - Thin clients such as PDAs