Instructor's Guide
by GLENN T. SMITH

to accompany
Second Edition

DATABASE PROCESSING

David Kroenke

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DATABASE PROCESSING: Fundamentals, Design, Implementation

SECOND EDITION David M. Kroenke

SRA
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USE OF THE INSTRUCTOR'S GUIDE

This manual is divided into three sections. The first section provides introductory material, a conversion guide for users of the first edition, course outlines, and general suggestions for the instructor.

The second section provides teaching materials. This section is divided into chapters with five parts per chapter.

1. Objectives
   These objectives specify the major points that the students should accomplish by study of the chapter.
2. Teaching Suggestions
   These are suggestions on how to present the material in the chapter. They are in the form of what to emphasize, extra comments about the chapter, and suggestions for class activities.
3. Chapter Outlines
   These general outlines follow the sequence of the chapters in the basic text and point out the major concepts presented in those chapters.
4. Suggested Answers to Group I Questions
   These are suggested solutions to the Group I questions included at the end of each chapter of the basic text. Where appropriate they describe how the solution was derived.
5. Quiz Questions
   These are true-false, multiple choice, and, for most chapters, short answer questions. The Group I questions at the end of each chapter also provide a source for short answer quiz questions.

The last section contains transparency masters for most of the chapters.

TEACHING THE DATABASE COURSE

Teaching the database course can be a very rewarding experience. As with most computer courses, it can also be a large amount of work. Students tend to ask more questions and generally be more inquisitive. The area is constantly changing, so staying current requires a considerable amount of time. Testing, grading, and individual student help requires more time. This instructor's guide is aimed toward helping with some of these problems.

The chapter objectives and teaching suggestions are a good place to start preparing a unit. If these objectives are accomplished, you have accomplished the intent of the course. The teaching suggestions also give ideas for class presentations and material.

To prepare for a lecture, it is suggested that you read the chapter outline provided in this guide before reading the chapter. This will give more insight as to what material to look for in the chapter. As an extra preparation step, read the Suggested Answers to Group I Questions. This can point out areas that you may not be familiar or comfortable with. After this preparation, the text material should easily fall in place.

The quiz questions in this guide are provided as a pool to build a test. The objective questions are provided to ease the grading, however; because of the nature of the material, some short answer questions and problems should also be given. Students feel better about a test when they are given the opportunity to express what they know. Questions from the Group I questions at the end of the chapters in the basic text can be used for this.

Students tend to feel more comfortable with material than they really are. For this reason, it is suggested that grading be supplemented with homework and projects. The questions from Group I at the end of the chapters in the basic text can be used for homework. The projects at the end of each chapter are super learning devices. It is important that students do some work with a Database Management System. Implementing the Sally Enterprises database would be an option here. If there is no DBMS available, implementation of the projects in Chapters 3 and 4 would help their understanding of these concepts. This requires more work on the instructor's part and much more work on the student's part, however it is well worth the extra effort. Students tend to complain while doing the work, however they feel much better about a course that makes them work. Remember, a wheel that doesn't squeak occasionally, probably doesn't work.

NOTE FOR USERS OF THE FIRST EDITION

The second edition of Kroenke's Database Processing has omitted several chapters that appeared in the first edition, added several new chapters, and expanded and reorganized the other chapters. Changes that run throughout the text are the use of the Sally Enterprises case and the replacement of flowcharts with pseudocode and structured design techniques. Coverage of the relational model and the CODASYL DBTG model has been expanded. Several chapters on database design have been added. The chapter on DL/I has been moved to an appendix. The following tables summarize the changes as well as the correspondence from one edition to the other. As a double cross-reference, Table I lists the chapters in the second edition first, and Table II lists the chapters in the first edition first. Use whichever table is most convenient.

TABLE I

Second Edition	First Edition
Chapter 1	Chapter 1 with new material added towards the end of the chapter.
Chapter 2	Some material from Chapter 11 with the addition of the Sunshine Garden Supply case.
Chapter 3	Chapter 2 with the addition of material on virtual I/O.
Chapter 4	Chapters 3 and 4.
Chapter 5	New
Chapter 6	New
Chapter 7	Chapter 7
Chapter 8	Expands normalization from Chapter 7 and adds new material.
Chapter 9	Chapter 6
Chapter 10	New, includes some concepts from Chapter 6.
Chapter 11	Chapter 8 expanded.
Chapter 12	New
Chapter 13	IDMS from Chapter 10 greatly expanded.
Chapter 14	Chapter 12
Appendix A	Chapter 5
Appendix B	TOTAL from Chapter 9
Appendix C	New

TABLE II

First Edition	Second Edition
Chapter 1	Chapter 1
Chapter 2	Chapter 3
Chapter 3	Chapter 4
Chapter 4	Chapter 4
Chapter 5	Appendix A
Chapter 6	Chapter 9
Chapter 7	Chapter 7
Chapter 8	Chapter 11
Chapter 9	Omitted (TOTAL covered in Appendix B)
Chapter 10	Omitted (IDMS covered in Chapter 13)
Chapter 11	Chapter 2
Chapter 12	Chapter 14

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SUGGESTED COURSE OUTLINES

Computer-oriented degrees are typically found in two schools: the School of Business and the School of Computer Science and Mathematics. The orientations and direction of these degrees are different. In the School of Business, the degree is oriented around accounting, finance, economics, and the core business courses, with computer-related courses in COBOL, systems analysis, systems design, and information systems theory. In the School of Computer Science and Mathematics, the degree is typically oriented around Pascal, assembler language, compiler design, systems programming, and algorithm development. These degree programs are oriented more toward the internals of the machine and languages than the business degrees. In the database course, these two differences in degree programs lead the database course in different directions. The computer science degree is typically oriented more toward the database management system design; whereas the business degree is oriented more toward the design of the database itself. In today's world, the student must know both. One cannot design a database management system without knowing something about database design. Likewise, one cannot design a database without some understanding of the internal workings of a database management system. This text is geared toward both. Plenty of material for database design is covered along with plenty of material on database management systems. However, because of the different backgrounds of students and their interests, two different course outlines are provided. Their primary differences are in the time spent on particular chapters. Please examine both outlines before determining which fits you. Many MIS degrees are housed in the Computer Science schools and many computer science programs are housed in the School of Business.

The preferred order to cover the chapters is in the order presented in the text. The only other logical order is to cover chapters 7, 8, 11 and 12, then cover chapters 9, 10, and 13. This order places all the chapters on the relational model together and all the chapters on the CODASYL DBTG model together. These groupings could be reversed, however either chapters 7 and 8, or chapters 9 and 10 should be covered before Chapter 11. These chapters introduce some of the concepts for chapter 11. Chapter 11 must be covered before either chapter 12 or 13.

Computer Science Database Course

Chapters 1 and 2 give a good overview of the database processing environment. Computer science graduates will eventually work with business people and they must understand business terminology. Chapter 2 gives a computer science major a good insight into the business world.

In the computer science course, the input/output processing will most likely be a review of other course work. Chapter 3 can be covered as a review, and chapter 4 can be covered lightly if your program has a data structures course. This chapter should not be skipped altogether. It contains material that is a necessity for the later chapters. Chapter 4 is also the place where students can see the applications of trees and networks and realize that material learned in the classroom is applicable to the real world.

Chapters 5 and 6 introduce the concepts of logical database design. These chapters are imperative for understanding of the remainder of the text. Chapters 7 and 8 cover the relational model. These chapters are closer to the heart of the pure computer scientist. Chapters 9 and 10 cover the CODASYL DBTG model. This model is oriented toward the business major because of the COBOL and file processing orientation.

Chapter 11 is a very important chapter. It discusses concurrent processing, recovery, and security. There are plenty of areas discussed in this chapter to challenge the brightest student. Implementation of the concepts in this chapter can pull much of a computer science program together. Chapter 12 discusses implementation of the relational model using SQL/DS, whereas Chapter 13 implements the DBTG model using IDMS. Chapter 14 covers the responsibilities of database management. The concept of database management is important. Students must realize that there is more involved than design and implementation. The database must be managed throughout its lifetime.

For schools on the quarter system, the chapters must be covered lightly because of time. A two quarter course would be preferred. The first quarter could cover logical design concepts and the second quarter could cover implementation.

Suggested Computer Science Course Outline

Chapter	Semester Hours	Quarter Hours
1. Introduction	1	1
2. The Database Development Process	3	2
3. Input/Output Processing and File Organization	2	2
4. Data Structures for Database Processing	4	3
5. Introduction to Database Design	3	2
6. Logical Database Design	4	2
7. The Relational Model	3	2
8. Relational Database Design	4	3
9. The CODASYL Model	3	2
10. Physical Design Using the CODASYL DBTG Model	2	1
11. Functions of a Database Management System	4	2
12. Relational Database Implementation	3	2
13. CODASYL DBTG Database Implementation	2	2
14. Database Administration	2	1
Exams, Reviews, and Projects	5	3
	45	30

The Information Systems Database Course

The information systems course differs from the computer science course in several ways. First, the information systems course approaches computer systems as tools to be used rather than machines to be built or designed. The orientation of the course work is from the view of the user rather than the computer designer. Second, where computer science majors have probably taken a data structures course, information systems majors have probably taken a systems analysis and design course. Third, the information systems major will deal more with the design of the database than the database management system. This means that the informations system course should spend more time on Chapters 3 and 4, since they do not have this background. Much of Chapters 1 and 2 will probably be a review. Also, the information systems major will be more comfortable with the CODASYL DBTG model than with the relational model. However, this should not mean that the relational model is treated lightly. Chapter 11 should be covered from a view of problem prevention, rather that DBMS implementation.

Suggested Information System Course Outline

Chapter	Semester Hours	Quarter Hours
1. Introduction	1	1
2. The Database Development Process	3	2
3. Input/Output Processing and File Organization	3	2
4. Data Structures for Database Processing	5	3
5. Introduction to Database Design	3	2
6. Logical Database Design	3	2
7. The Relational Model	2	2
8. Relational Database Design	3	1
9. The CODASYL Model	3	2
10. Physical Design Using the CODASYL DBTG Model	3	3
11. Functions of a Database Management System	3	2
12. Relational Database Implementation	3	2
13. CODASYL DBTG Database Implementation	3	2
14. Database Administration	2	1
Exams, Reviews, and Projects	5	3
	45	30

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CHAPTER 1

INTRODUCTION

OBJECTIVES

.To distinguish database processing from file processing.
.To understand the advantages and disadvantages of database processing.
.To identify the role that each of the five components of a database system play.
.To define the terms byte, field, logical and physical record, logical and physical file, primary and secondary key, unique and nonunique key, schema, subschema, and internal view.

TEACHING SUGGESTIONS

1. Introduce the course by explaining that database processing seems to be the way of the future. The demand for knowledgeable people is high but the supply is low. Knowledge of the material covered in this course could put the student on the top of the employer's most wanted list.
2. Start with a comparison of database and file processing since most students will be familiar with file processing. Use transparencies 1-1 and 1-2.
3. Point out that this is an information society in an information age and that database promises a solution to our information society's requirements.
4. Explain that for students in a Management Information Systems program, database processing offers the technology to implement MIS.
5. Point out the disadvantages of database processing. There are many disaster stories and many problems that database processing creates. This is more because of a lack of knowledge of database processing than problems inherent in it.
6. Since most students have just completed the experience of registration, use this as an example when explaining the five database components.
7. Concentrate on the five components of database processing. Students need to learn early that computer processing systems consist of more than hardware and programs.

CHAPTER OUTLINE

I. Database Systems
   A. File processing systems create files that are designed for a single application. They have the problems of data duplication (causes poor data integrity), program data dependence (raises maintenance costs), difficult or impossible integrated processing of files, and unique requests that are too expensive. The data is not treated as shared data.
   B. Database processing resolves most of the problems present in file processing systems. It reduces data duplication, provides program data independence, provides integrated affordable programming and better data maintenance. More information can be obtained from the same amount of data because of the integrated processing.
   C. Database processing has several disadvantages. The cost of the DBMS is high ($100,000), more memory and online storage is needed, systems are more complex, and development is slower. Some systems will run slower, especially sequential processing. Recovery is more difficult and data is more vulnerable.

II. Components of database processing systems
   A. Hardware
      1. No special hardware is required; however, more memory and online storage may be needed along with a faster CPU.
      2. Database machines are available. These are small special purpose computers that handle the functions of the DBMS. These machines relieve the main CPU of the overhead generated by database processing.

B. Programs
   1. The communications control program routes messages from one application or user to another. It also performs communications error handling and terminal handling.
   2. Applications programs are normally written in higher level languages, like COBOL, to satisfy user needs.
   3. Utility programs provide many functions neccessary to create, maintain, and interrogate the database.
   4. The database management system provides routines to define the database, store and retrieve data, provide security, and handle concurrent processing.
   5. The operating system manages the resources of the computer.

C. Data
   1. Data consists of characters, fields or data items, records, and files. Files are logical collections of data rather than physical collections.
   2. Each record has a unique primary key. Records can also have secondary keys. These can be unique or nonunique. If nonunique, they identify a set of records.
   3. There are three views of the data. The schema is the logical view of the entire database: the universe. The subschema is a logical view of a subset or part of the database - one world in the universe. The internal view is a physical view of the database.

D. People
   1. Clientele use the information provided by the database system.
   2. Users interact directly with the database system.
   3. Operations personnel are concerned with the physical security of the database, operation of the computer center, backup, and recovery.
   4. System developers analyze requirements, design, and implement the database system.
   5. Database administration acts as the guardian of the database system and resolves conflicts among users.

E. Procedures
   Each of the database personnel need different procedures. These procedures involve using the database system, identifying and solving problems, and providing backup and recovery.

SUGGESTED ANSWERS TO GROUP I QUESTIONS

1.1 In a file processing system each application has its own set of files. The data that resides on the files and the organization of the files is designed to maximize that application's processing. The application accesses the data directly. Each application that accesses the data must provide a description of the data.

In a database processing system the data and the organization of the data are designed to process many different applications. The applications do not access the data directly; they call on the database management system and it accesses the data. The database is self-describing, it contains its own description of the data. Both records and files are logical as opposed to physical records and files.

1.2 Database processing advantages
   a. Can obtain more information from the same data
   b. New requests and one-of-a-kind requests more easily implemented
   c. Elimination or reduction of duplicated data
   d. Program data independence
   e. Better data management
   f. Affordable sophisticated programming

See Figure 1.4.

1.3 Database processing disadvantages
   a. Expensive
      1. Database management system (purchase or development cost)
      2. More hardware (memory, auxiliary storage)
      3. Higher operating costs
   b. More complex development
   c. Recovery more difficult
   d. Increased vulnerability to failure
      See Figure 1.5.

1.4 When the cost of an average transaction passes the point of minimum cost on the average cost curve. This is caused by increased complexity of the database.
      See Figure 1.3.

1.5 No. To this date database systems do not require special hardware; however, they may require more hardware (memory, auxiliary storage, faster CPU).
   Recently, several vendors have announced database machines. These machines perform the database management functions and allow database processing to be performed simultaneously with applications processing. This might be necessary if the amount of database processing were so great that it required too much of the system's resources to allow the other data processing tasks to be accomplished.

1.6 Database processing involves the following major categories of programs:
   a. Communications Control Program (CCP) - The CCP provides for communications error checking and correction, coordinates terminal activity, routes messages to the correct next destination, formats messages for various types of terminal equipment, and performs other communications tasks.
   b. Applications Programs - These applications are written to process data on the database. They satisfy specific needs such as order entry, inventory, accounting, billing, and so forth.
   c. Utility Programs - Query/update utilities provide for generalized retrieval and update of the database. These can be used by nonprogrammers to interrogate the database. They also enable users to define and obtain reports with minimal programmer involvement. Other utilities are provided to create and maintain the database. Examples are utilities to generate the database structure, to load or reload the database data, to reformat and clean up the database, and so forth.
   d. Database Management System:
      1. Defines and stores the database stucture
      2. Loads database data
      3. Provides a wide variety of access methods
      4. Stores and maintains the data
      5. Provides multiple views of the data
      6. Provides security features
      7. Enables control over concurrent operations
      8. Facilitates backup and recovery
         See Figure 1-8
   e. Operating System - This set of programs controls the computer's resources. It handles the DBMS's requests for input and output, handles messages between programs, and controls all the computer's resources.

1.7 A database is a self-describing collection of integrated files. More specifically, a database contains a description of its data, the data, and overhead data that provides relationships between the database files.

1.8 The term <u>self-describing</u> means that within the database there is a description of the data contained within the database. Therefore, the database needs no external description.

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1.9 Webster defines the term integrated as "combining or coordinating separate elements so as to provide a harmonious, interrelated whole." When files are integrated, they are viewed as a single file. The individual files must carry data that forms relationships between different records in different files. This allows the user to view records from different files as a single record or single file.

1.10 A database is not a collection of files in the traditional sense. In the traditional view of files, each file is a collection of records with the same format, containing like data about people, places, or things. The records on a specific file are physically stored one after the other on the same device.

In a database the records on a file may or may not be stored together physically. Records from several database files may occur as a contiguous group of records. The files become logical files, as opposed to physical files. Also the records in one file will contain relationships to records in other files. This is not true in the traditional file concept.

1.11 A nonunique key is a key that identifies a group of records. An example would be hair color (identify all people with red hair), student rank (identify all freshmen), or book subject (identify all books about database).

1.12 Database data has been categorized into the following views:

a. Schema or conceptual view - This is a complete logical view of the data as the human would view it.
b. Subschema or conceptual view - This is a subset or partial view of the database as seen by a particular application or user. There are normally several subschemas for the database and they may logically reorganize the schema. Fields can be renamed or reordered and sometimes new or modified relationships can be defined.
c. Internal or physical view - This is the form of the data as it appears to the particular processing computer. It is how the data is physically arranged and allocated to the files. This view is usually created by the DBMS.

See Figure 1.11.

1.13 Job responsibilities:

a. Clientele - These are users of the information obtained from the database. They do not usually have an active role in database development or use.
b. Users - These are the people that employ the system to satisfy a business need. Their responsibilities deal with the use of the data in the database. They must assure that updates are done properly and that proper procedures are followed.
c. Operations - These people operate the computer. Typically, the operations department includes machine operators, data control personnel and data entry personnel. Their responsibilities include recovery, backup, physical security, and general computer operations.
d. Systems development personnel - These people design and implement the database system. They determine requirements, specify alternatives, design the five components of the database system, and manage implementation. An important function of these personnel is the design of the database structure or schema.
e. Database administration - The database administration staff has the responsibility of protecting the database and resolving conflicts between users.

1.14 Procedures needed:

a. Users - The users need to know how to sign on to the system, how to use terminals, how to provide data and procedures to assure that they do not interfere with one another.
b. Operations - These personnel need procedures for both starting and stopping the database applications and for providing backup and recovery. They also need procedures to follow when the database system fails.
c. Database administration - These personnel need procedures for control of the data and for control of changes to the database structure. They need procedures to facilitate changes needed by the users.

1.15 One example would be a hospital database. The two files would be the patient master file with patient number, name, and address. Other files would be prescription, charges, or medical history. The primary unique key would be a patient number assigned when the patient entered the hospital (a Social Security Number could be used but small children may not have one). A unique secondary key would be a Social Security Number, and nonunique secondary keys would be room number, ward number, or doctor.

CHAPTER QUIZ

TRUE-FALSE

F 1. Recent trends in the computer industry indicate that employees will be getting cheaper as machines get more expensive.

T 2. In a database environment, a database management system separates the user or application program from the data.

F 3. Reduction or elimination of duplicated data will not help increase data integrity.

F 4. All processing can be performed faster using database processing than it can by using traditional file processing.

T 5. Database processing provides more ways to access the data than traditional file processing.

F 6. Normally there is only one database for an organization.

T 7. Database processing may require more hardware but it does not require special hardware.

F 8. In a database, a physical file and a logical file are the same.

T 9. Query/update utilities provide a method for nonprogrammers to interrogate and update the database.

F 10. The database management system sends requests for input/output services to the communications control program and the CCP performs the input/output service.

T 11. A nonunique key identifies a group of records that have the same value for a given field.

F 12. All three views of the data - conceptual, external, and internal - are defined by the database administration staff.

F 13. The database administration personnel design and implement the database system.

T 14. The prime responsibility of the database administration staff is to provide a forum for change.

F 15. Since database users are not involved with the design or implementation of the database system, they do not need procedures.

MULTIPLE CHOICE

1. Database processing can provide program/data independence because
   * a. the database is self-describing
   b. the database contains relationships between the files
   c. the operating system provides the input/output services
   d. the database contains little or no data duplication

2. The primary reason people develop database systems is to
   a. decrease the cost of an average transaction
   b. provide the ability for multiple users to share data
   * c. obtain more information from a given amount of data
   d. keep up with state-of-the-art processing

3. The primary cause of data integrity problems is
   * a. data duplication
   b. lack of program data independence
   c. lack of relationships among data
   d. no query/update languages

4. Which of the following is not an advantage of database processing:
   a. It reduces data duplication.
   * b. It requires less main memory.
   c. It provides for better data management.
   d. It reduces the amount of program maintenance as a result of changes to the data.

5. Which of the following is a disadvantage of database processing:
   a. Special hardware is required.
   * b. Recovery from failures is more difficult.
   c. One-of-a-kind requests are more difficult to implement.
   d. Batch processing cannot be performed.

6. One advantage of database machines is that
   a. they are cheaper than database software
   b. they have been on the market longer than database software so all the bugs have been removed
   c. they provide more access techniques than database software
   * d. database processing can be performed simultaneously with applications processing

7. The program that routes messages to their correct destination is the
   * a. communications control program
   b. operating system
   c. database utilities
   d. applications software

8. Which of the following programs would probably load or unload the database:
   a. operating system
   b. communications control program
   * c. database utility
   d. applications program

9. Which of the following programs would probably be written in-house by the data processing staff:
   a. database management system
   * b. application programs
   c. operating system
   d. query/update utilities

10. The schema or conceptual view of the database is
   a. the way the data is physically stored on a device
   b. the way the data is processed by a particular application
   * c. the logical view of the entire database
   d. the logical view of the database for one application or user

11. The view of one application or user is referred to as the
   a. schema
   * b. subschema
   c. internal view
   d. conceptual view

12. The person who would use the database to obtain a list of all persons ready to retire would be a
    * a. user
    b. system operator
    c. system developer
    d. database administrator

13. The personnel who would define the database structure would be the
    a. users
    * b. system developers
    c. system clientele
    d. database administration

14. The responsibility of the database administration staff is to
    a. write applications programs
    b. design the physical structure of the database
    c. oversee the operations of the computer center
    * d. resolve conflicts amoung users

15. Procedures about how to change the structure of the database would be needed by
    a. clientele
    b. users
    c. operations personnel
    * d. database administration staff

SHORT ANSWER

1. Proponents of file processing will argue that all the advantages of database processing can be obtained with file processing. Respond to this argument.

   It will require more applications programming to write the sophisticated and complex data management code. Since the current rise in cost is the cost of people, the development will be too expensive. Also, this will require programmers with a great deal of skill and experience. These people are very scarce and expensive, and projections are that they will get more scarce and more expensive.

2. Why will database processing require more main memory?

   Since the database management system is a program, it must reside in main memory while it is executing. The DBMS is a large and complex program; therefore, it may require such a large amount of memory that there may not be sufficient room for the applications programs. Even with virtual memory the amount of paging required may be unacceptable.

3. Explain the purpose of a nonunique key.

   A nonunique key is used to locate a set of records that have a specific characteristic in common. An example would be checks for a specific checking account. The nonunique key for checks would be the checking account number.

4. How does a subschema differ from a schema?

   A subschema is a partial view of the database. The schema is a view of the entire database. Subchemas may provide views of the data that do not exist in the schema.

5. Why is backup and recovery more difficult in a database environment?

   Backup and recovery is more difficult because the data is shared. Several users may be processing the data concurrently. If a failure occurs, it is difficult to determine the exact status of each user at the time of the failure. Each user must be notified as to which transactions were lost and which transactions were recovered.

CHAPTER 2

THE DATABASE DEVELOPMENT PROCESS

OBJECTIVES

.To describe the stages of systems development.
.To interpret data flow diagrams for existing systems.
.To identify alternatives for the five components of a database processing system.
.To identify both subjective and objective techniques for evaluating alternatives.
.To identify the tasks involved in design and implementation of a database processing system.

TEACHING SUGGESTIONS

1. For students in an information systems or data processing program much of this chapter may be a review of a systems analysis and design course. For most computer science majors this may be their first exposure to the business side of systems development. Since most computer science majors will eventually work for business people, they need to know the business terminology and principles that are introduced in this chapter. It gives them insight into what happens on the front end of systems development.
2. Introduce this chapter with a simple example of the development process. One approach to this is to have the students explain how they approach writing a term paper. Hopefully they will begin with a problem definition or paper topic. Next should come an evaluation of the alternative sources of material for the paper (periodicals, textbooks, interviews). Then the design step, the paper outline, followed by the implementation, which is writing the paper.
3. If the above approach is used, it will be easy to discuss such things as requirements (define the requirements for the paper and make the paper meet the requirements), scope (limit the scope of the paper), alternatives selection (you must select which articles to use), and implementation (format for the paper and timetable for completion).
4. You might suggest that with query languages and the development of very high level languages the future seems to lie more in the design of systems than in programming.
5. Point out that the function of business is to make profits. Since the cost of database processing can be very expensive, the feasibility of such a move must be cost justified early in the process.
6. An interesting note to make with this chapter concerning cost benefit analysis is to use examples like airlines reservations. Many consider that overbooking a flight and giving free flights to those without a seat is less expensive than guaranteeing that the flight is not overbooked. Also, the Department of the Navy once conducted a study that revealed it would be cheaper to pay close to $100,000 a month in law suits than to guarantee that all their employee data was accurate.

CHAPTER OUTLINE

I. The Database Development Process
   A. The development process for database systems is just like any other system, only harder. Some of the reasons are that you are dealing with more data elements, the data must be related in some logical manner, and the data is shared.
   B. A common violation of the development process is to set out to build a database system. Database processing should be an alternative but not the target.

II. Specification Stage
   A. Conduct a problem definition and feasibility study. This step is short. It determines the technical, cost, and schedule feasibility of a computer solution.

B. Specify detailed user requirements.
   1. Develop the project team. It should consist of users and system developers, and it should report to a senior executive.
   2. Interview users to obtain the detailed requirements. The system is built to meet their needs. No one knows the needs of the users better than the users themselves.
   3. Document the existing system. Develop the data flow diagrams, specification data dictionary, and process descriptions.
   4. Develop the detailed requirements into an objectives journal for later documentation and use. Users have the final approval of the detailed requirements.

III. Evaluation
   A. Identify alternatives for each of the five database processing system components
      1. Data - Identify what data items are required and what types of files can be used.
      2. Programs - If DBMS is considered, then the type of DBMS must be considered. The hardware available will eliminate some systems. Also consider the application programs needed, the language to use, and the role of query/update languages.
      3. Hardware - Consider how much additional memory and online storage will be required. Moving to a database machine should also be considered.
      4. Procedures - Procedures take only a minor role at this stage. They are considered when different styles of use require different hardware or data designs.
      5. People - Database administration responsibilities must be addressed. The database administrator manages database activity, controls the database structure, and manages database resources.
   B. Select an alternative
      1. Use subjective evaluation techniques to compare relative benefits to costs. The result is an intuitive selection.
      2. Evaluate possible database management systems. DATAPRO or Auerbach are good sources. An alternatives rating form can also be used.
      3. Perform cost/benefit analysis. Compute a return on investment to determine the alternative.
      4. Develop the project plan. It identifies the major activities, task dependencies, labor estimates, and project schedule.
      5. Have management review the alternative selection recommendation and determine if changes in the plan need to be made.

IV. Design Stage
   A. Both the logical and physical structures for the database are designed.
   B. Programs are designed and data collection begins. Hardware is ordered if needed. Procedures for security, control, backup, and recovery are designed.
   C. The responsibilities and authorities of the database administrator are finalized. The DBA office is organized and established.

V. Implementation
   A. Create the database structure and create a test database.
   B. Document procedures and train personnel.
   C. Perform parallel test with the old system.

VI. Sunshine Garden Supply Case

The Sunshine Garden Supply case is an application of the material covered earlier in the chapter. It is very important for students to see the relationship between the conceptual learnings and the application of those learnings. The Sunshine Garden Supply example shows this relationship and for this reason it should be covered well.

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