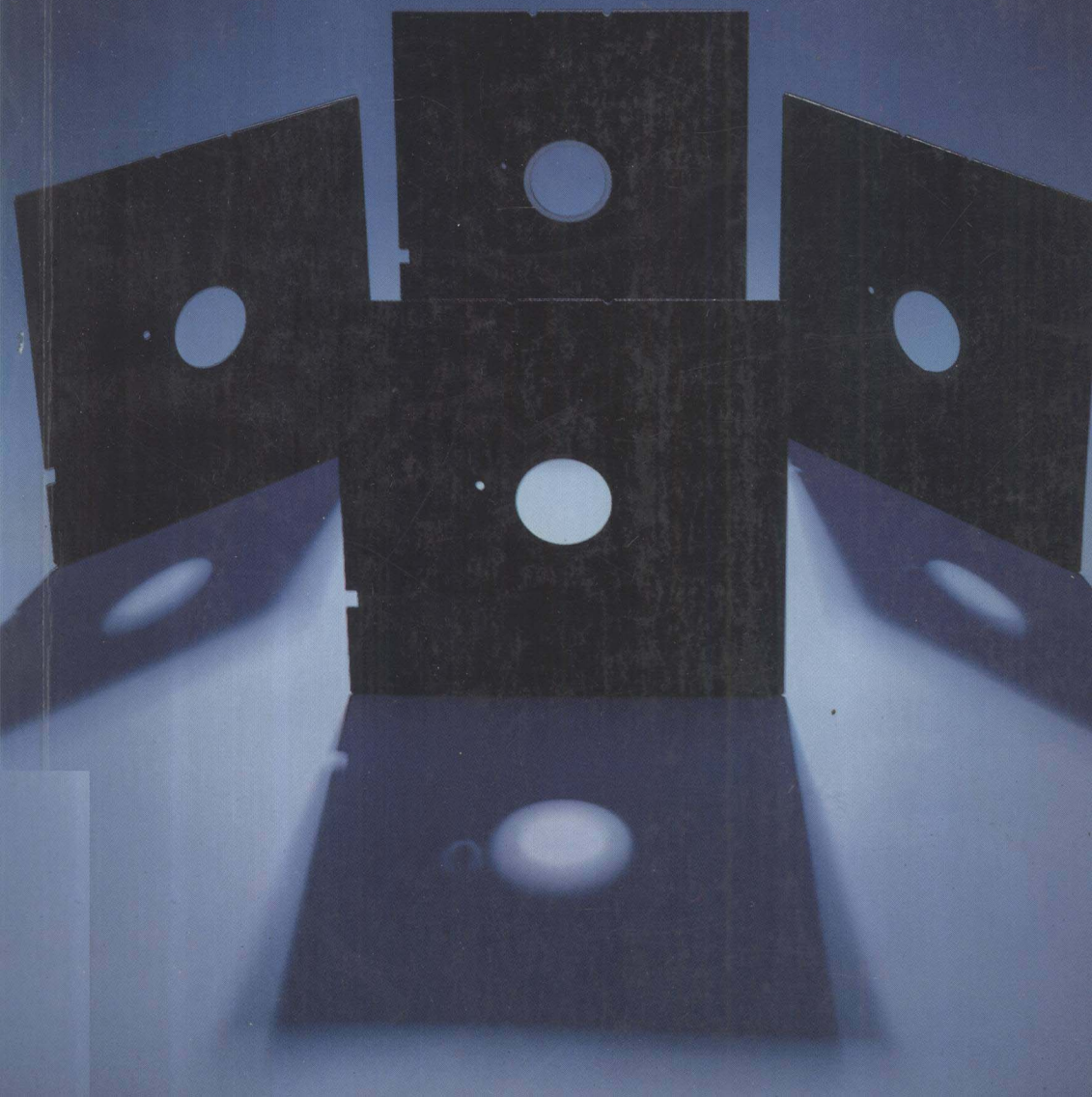


Introduction to Database on Microcomputers

Geoff Sharman



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IBM United Kingdom Laboratories Limited



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Introduction to Database on Microcomputers

To Jenny

Preface

The IBM Personal Computer is now acknowledged as one of the leading microcomputers designed for general use. It may be found in the office, in schools and colleges, and in homes, although its greatest strength is probably in the area of business. As a result, it has probably the largest range of software packages of any currently available machine.

Despite this, it is generally agreed that almost all significant business application systems fall within a few major categories; namely, word processing, spreadsheets, graphics packages, database systems, and accounting packages. All of these are general-purpose functions in the sense that they may be applied to more than one business and, in most cases, more than one type of business.

Of these five categories, probably the least well understood is that of database systems. Yet a database is simply the computer equivalent of a card index or a filing cabinet, and is intended to support one of the most pervasive of all business activities, namely record keeping. Computer databases have proved extremely effective over the past two decades, and almost all large organizations now use them to manage some aspect of their business such as personnel records, customer lists, inventories, and so on. As computers become cheaper, smaller businesses are following this trend, and databases are likely to become a major use of personal computers in the future.

This book is intended for the IBM Personal Computer user who wants to understand how database techniques may be employed in business applications, how to design and develop database applications, or how to select a database product for the personal computer. It may also be useful to students who are taking a course in personal computing or a database module as part of a course in business management, data processing or computer science, and to teachers who are preparing such courses.

The book consists of four parts which deal with basic concepts, how to develop a database application, more advanced concepts, and tutorial introductions to some representative database products. The primary intention is to help you succeed in the practical task of building a database for yourself. However, each part of the book may be read independently as a primer, or used for reference if so desired.

The first part presents database concepts at an introductory level using a standard approach based on the entity-relationship theory of database. Simple explanations of the longer established hierarchical, network, and relational database theories are given in terms of this standard approach. This provides a basis for understanding the database products which are available for the IBM Personal Computer and evaluating their capabilities. A number of application examples are developed as 'themes' which are used to illustrate important concepts as they are introduced, and these are linked to practical case studies and exercises.

The second part describes application development techniques which are based on the author's practical experience of personal database systems over a 10-year period. They provide an introduction to the methods of project management, and are designed for personal computer users who are not professional programmers. They can be applied to a wide range of applications for the IBM PC, illustrated by the detailed case studies provided.

The third part explains in greater depth how a database system works. Some of this material is fairly technical and need not be read at first. However, it provides an essential basis for evaluating the large variety of dissimilar systems which are on offer. You are strongly recommended to read this before making a decision to buy a database product.

Part 4 presents tutorial introductions to a number of well known database products. These tutorials are not intended to replace the reference manuals for the products, but rather to provide a way of rapidly getting to grips with a particular product. They should also give you an appreciation of the range of products available and a basis for comparing them. Each product is illustrated by examples which are drawn from those used in the first two parts of the book.

Throughout the book, the reader is assumed to be familiar with one of the IBM PC, PC/XT or PC/AT computers and with the PC-DOS operating system, but no prior knowledge of database systems is required.

I have found that database systems can become a compelling interest, and would like to thank many colleagues at IBM for their help and stimulating company over the years. Particular thanks go to Chris Date, Bill Kent, Mike Senko, and Norman Winterbottom for contributing to a lifelong interest in this fascinating subject, and to many IBM managers for their support during various projects. I would also like acknowledge many rewarding discussions with database researchers around the world, especially those with Don Jardine, Peter King, Douglas McGregor, and Tom Steel, which have led me to see unexpected depths in the apparently mundane business of keeping track of reality.

I would like to emphasize that the views expressed in this book are my own, and not necessarily those of IBM, and to thank all those who have helped in the production of this book. Special thanks go to Peter McManus, the members of the joint IBM/Addison-Wesley Editorial Board, staff of IBM Entry Systems Europe, and the Information Systems staff of IBM United Kingdom Laboratories Ltd. I am grateful to the Michelin Tyre Company for permission to use material from their excellent *Red Guide* to French hotels and restaurants as examples and to Pan Books for permission to use the quote from Douglas Adams' *The Hitch-hiker's Guide to the Galaxy*.

Finally, I would like to express the hope that this book may help many people to find a better way of solving at least some of their business problems.

Winchester, England

G. C. H. Sharman
December 1986

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Contents

Preface	vii
Part 1 BASIC CONCEPTS	1
Chapter 1 Why Database?	3
1.1 Some history	4
1.2 Data is an asset	4
1.3 What a database is not	5
1.4 What is a database?	6
1.5 Logical structure	7
1.6 Physical organization	9
1.7 Data independence	10
1.8 Where database systems are used	10
Chapter 2 How a Database Represents Information	13
2.1 Naming things	14
2.2 Recording facts	17
2.3 Defining rules	20
2.4 Rules for derived information	22
2.5 Querying information	24
Chapter 3 Files, Records and Databases	29
3.1 File structures	29
3.2 Normalization	32
3.3 Searching and sorting	35
3.4 Indexing	37
3.5 More advanced indexing	39
3.6 Using more than one file	40
3.7 Hierarchical databases	42
3.8 Network databases	44
3.9 Relational databases	45

Chapter 4	Some More Examples	49
4.1	Customer address list	49
4.2	Order entry system	51
4.3	Bill of materials	52
4.4	Personnel and organization system	54
4.5	Suggested exercises	57
Part 2	CREATING A DATABASE APPLICATION	59
Chapter 5	Gathering Requirements	60
5.1	Functional requirements	61
5.2	Operational requirements	64
5.3	Assessing feasibility	66
5.4	Business justification	69
5.5	The project plan	71
Chapter 6	Designing the Database	74
6.1	Designing the logical structure	74
6.2	Designing the physical organization	81
Chapter 7	Implementing the Database Application	89
7.1	Installing the database manager	89
7.2	Creating the database	91
7.3	Creating user views	93
7.4	Creating user dialogues	97
7.5	Creating printed reports	99
7.6	Documentation	101
Chapter 8	Commissioning the Application	103
8.1	Acceptance testing	103
8.2	Data capture	104
8.3	Parallel running	105
8.4	In production	106
Part 3	MORE ABOUT THE DATABASE SYSTEM	109
Chapter 9	The User Dialogue	110
9.1	Presenting information	111
9.2	Interacting with the presentation	115
9.3	Creating a new database	123

Chapter 10	Managing the Database	126
10.1	The functions of a database manager	127
10.2	Data retrieval and update	128
10.3	View definition	130
10.4	Database definition	132
Chapter 11	Integrity, Auditability and Security	140
11.1	Data integrity	140
11.2	The audit trail	142
11.3	Recovery procedures	144
11.4	Data security	145
Part 4	DATABASE PRODUCTS FOR THE IBM PERSONAL COMPUTER	151
Chapter 12	IBM Filing Assistant	152
12.1	General description	152
12.2	Using an existing database	154
12.3	Creating a new database	157
12.4	Implementing the vendor database	161
Chapter 13	DELTA 4	164
13.1	General description	164
13.2	Using an existing database	166
13.3	Creating a new database	174
13.4	Implementing the vendor database	177
Chapter 14	EVERYMAN	179
14.1	General description	179
14.2	Using an existing database	181
14.3	Creating a new database	189
14.4	Implementing the vendor database	193
Chapter 15	dBASE III	195
15.1	General description	195
15.2	Using an existing database	197
15.3	Creating a new database	207
15.4	Implementing the vendor database	211

Chapter 16	RBASE 5000	212
16.1	General description	212
16.2	Using an existing database	214
16.3	Creating a new database	224
16.4	Implementing the vendor database	228
	Glossary	231
	Bibliography	241
	Index	243

Part 1 | BASIC CONCEPTS

The first part of this book discusses the need for database systems and describes concepts which are common to all database systems. Chapter 1 introduces the idea of information as a business asset, and shows how a database maximizes the value of this asset by providing data independence. Chapter 2 shows how a database captures information by naming things and recording facts about those things. This leads to a standard method of describing the logical structure of a database, which underpins the rest of the book. Chapter 3 describes the physical organization of data as records and files, and explains the relative advantages and disadvantages of competing methods. Chapter 4 introduces typical examples of database structures which occur in business, and discusses the key features of these structures.

1 | Why Database?

'For knowledge itself is power.'

FRANCIS BACON, *Religious Meditations*

Just a short while ago, personal computers arrived on the scene and started to change people's lives. In the office, computers removed the drudgery from a whole variety of tasks by automating manual procedures. They even started to displace other office equipment, such as calculators, typewriters and word processors, which had previously been common. People discovered that computers could manipulate words, calculate tax returns or business projections, draw graphs, and even do the filing. There seemed to be no limit to the things computers could do.

Although the naked computer was a seemingly unimpressive machine, it could be transformed into almost anything by adding a software package. Thus a word processing package would convert the computer into a word processor, an accounting package would convert it into an accounting machine, a spreadsheet package would convert it into a rather powerful calculator, and a database package would convert it into an electronic filing system.

The effect of personal computers is still only beginning to be felt. The future is sure to hold more revelations, and no one really knows which applications will have the greatest long-term benefits. One thing is certain, however. Computerized filing systems will always be important because they deal with the storage, organization, and retrieval of information itself. Their purpose is to capture information and make it serve any task, in almost any business.

This book describes how to replace your card index or filing cabinet with an electronic filing system known as a **database**, which stores data on the computer's diskette or fixed disk. The information is kept from one session on the personal computer until the next. It is just as permanent as information stored on paper in a filing cabinet, but a lot less trouble. The computer makes life simple by storing data more compactly, retrieving it more rapidly, and making it easier to update.

Another real advantage is that you can index the information in many different ways. All conventional filing systems have difficulty

with cross-referencing. For example, if you file a series of documents by author there is no easy way of finding those on a particular subject. On the other hand, if you file them by subject there is no easy way of finding documents by a particular author. With a database you can have your cake and eat it: cross-referencing is no problem! This means that one database can solve a variety of problems.

1.1 SOME HISTORY

The first computer databases were built in the mid-1960s. They were needed for some of the major projects of the time, including the construction of the Apollo moon rockets. These spacecraft contained enormous numbers of parts assembled in very complex ways, so that building them was a modern-day feat equivalent to building the pyramids. Databases were essential to keep track of this huge complexity. Large investments were made in developing them, but despite this the first systems were cumbersome and not much more flexible than a conventional filing system.

As computers became more widespread, databases were used in manufacturing, banking, and insurance. There was no theory to guide the builder. Each database was developed in a trial and error fashion, and the resulting systems were completely incompatible with each other. After a while a number of patterns began to emerge, and these were moulded into working models by the inventors of the day. The best known models are still with us, and their inventors have become household names in the computing world: Charles Bachman of General Electric, Ted Codd and Mike Senko of IBM among them.

Since then new approaches have been discovered. Continuous research in database systems, by industry and universities, has built on the foundations established by the pioneers. Recent developments, among them the so-called relational database systems, have brought a new degree of simplicity for the user. Now, the personal computer has taken this a step further by making databases accessible to everyone.

1.2 DATA IS AN ASSET

In all areas of human life information has a value of its own. For example, everyone knows that governments around the world go to great lengths to obtain information about the defences of other countries. Naturally, these same governments spend a great deal of time protecting their own secret information. Obviously they value it highly. In business there is little information which compares with that relating to national security but, nevertheless, information can be extremely valuable. Common practices such as protection of trade