ELEMENTS OF PASCAL PROGRAMMING

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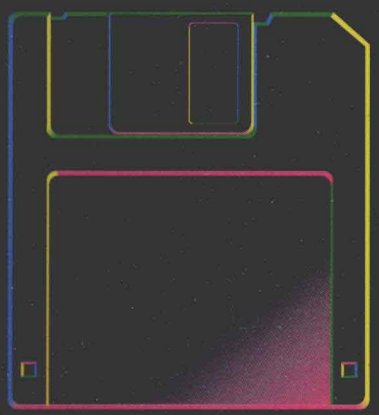

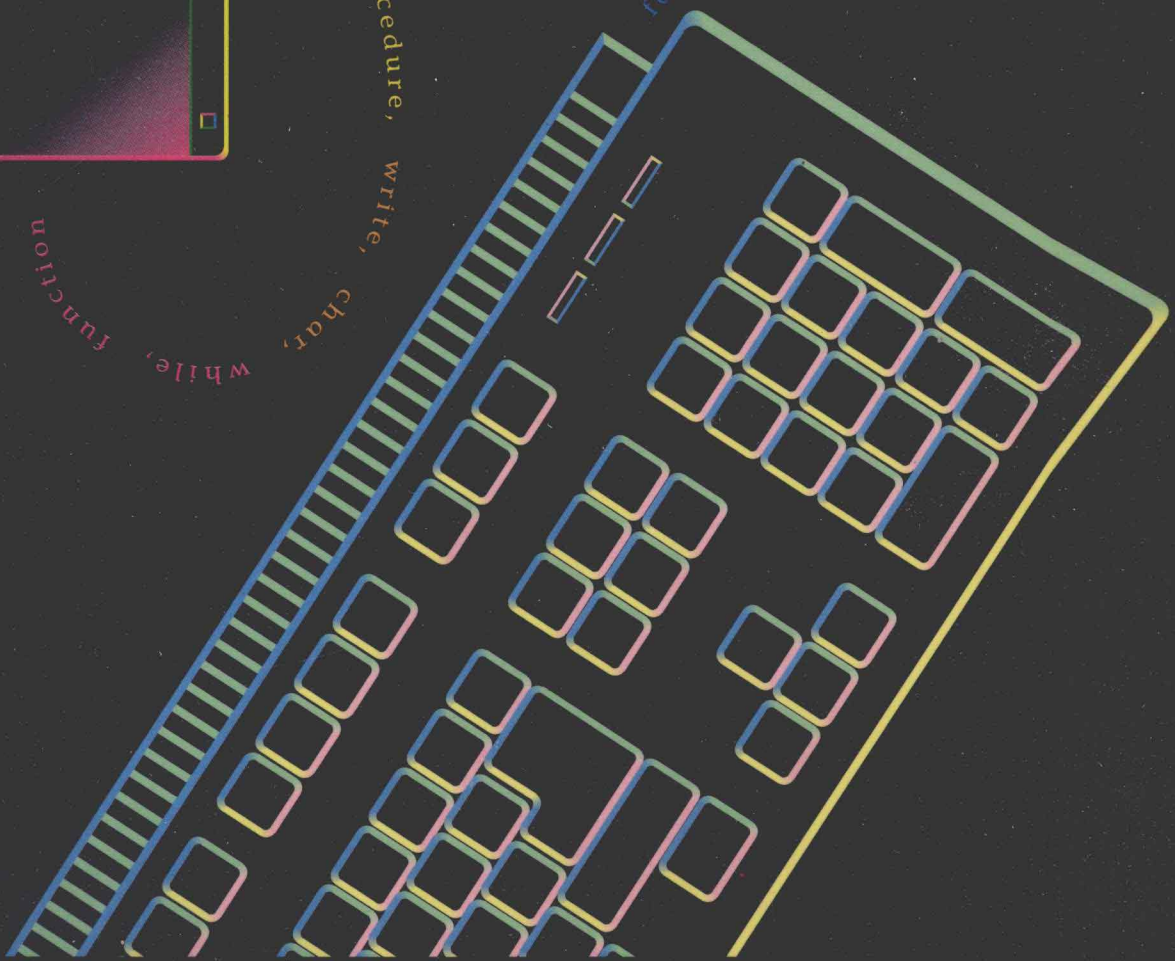

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Elements of Pascal Programming

Preface

For the past few years, the book "*Elements of BASIC programming*" by Mr. Y.T. Yu has proved itself to be a valuable text for students taking the Certificate Level Computer Studies course. In response to the release of the revised syllabus (1994) by the Curriculum Development Council, the book is now revised thoroughly and renamed as "*Elements of Pascal Programming*" to reflect the new emphasis on the Pascal programming language. There is now a separate chapter on the concept of data structures including queues, stacks and linked lists. Furthermore, the concept and applications of stepwise refinement are discussed in detail through programming examples and project exercises.

All programs in this book are written in Microsoft QuickPascal; editing, compilation and debugging are all discussed in the context of the QuickPascal environment.

"*Elements of Pascal Programming*" provides a comprehensive introduction to the Pascal programming language and, together with its accompanying text "*Elements of Computer Studies (Revised Edition)*", covered all the prescribed topics in the new syllabus to the necessary depth.

We believe that programming is learned most effectively by following through examples. The book provides plentiful of example programs together with the corresponding algorithms/flowcharts and clear explanations on how they are designed. As a useful aid, appropriate sample outputs are usually provided to accompany the example programs.

In order to provide the best help to students, the following features are incorporated:

(1) The text is written in simple English.

(2) Important terms, key concepts and definitions are suitably highlighted. Extensive use of tables is made for easy reference.

(3) Useful English terms are followed by their Chinese translation to facilitate learning.

(4) All program listing are reproduced directly from the computer and should execute correctly in the QuickPascal environment. All the example programs are collected in floppy disks for students to use.

(5) Each chapter ends with a summary and an adequate amount of exercises for effective revision and consolidation. The exercises include the construction of new programs as well as modifications and debugging of given programs.

(6) A number of project exercises are also included in the last chapter to illustrate various concepts of the Pascal language and systematic program design in a relevant context.

(7) Past HKCEE questions are included (some of which have been modified) in the exercises to familiarize students with examination requirements.

Acknowledgments

We are extremely grateful to all those who have participated in the development and production of this book. Our special thanks go to Mr. Kafe Luk and Mr. Louis Leung for their professional and thoughtful advices and comments. We are also grateful to Mr. Kenneth Ma for initiating this project.

Lastly we wish to acknowledge the Hong Kong Examinations Authority for permission to use questions taken from past HKCEE papers.

Any comments or criticisms will be greatly appreciated.

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Chapter 1

Preliminary concepts

1. Types of computers

Nowadays, computers come in different sizes and shapes. There are those huge and costly **mainframe computers** (大型電腦) (Fig. 1.1) which occupy large areas and require specially controlled environment (temperature and humidity) to operate. They are mainly used in governments, universities and large corporations.

Fig. 1.1 A mainframe computer

There are also other relatively less expensive **minicomputers** (小型電腦) (Fig. 1.2) which offer more or less the same performance as the mainframes, even though their sizes are smaller.

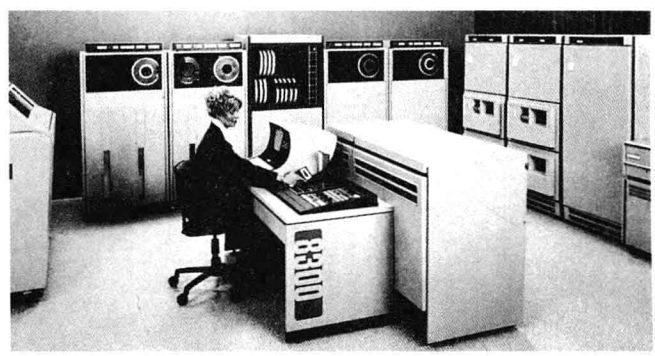


Fig. 1.2 A minicomputer

Thanks to the rapid advances in micro-electronics technology, there are now those small **microcomputers** (微型電腦) (Fig. 1.3) whose prices are affordable by small companies and even individuals. The capability as well as capacity have improved dramatically in recent years. Their performance approaches (and in some cases even excels) that of the minicomputers. As a result, microcomputers are so popular that they are found in many schools, offices and homes.

Fig. 1.3 An IBM PS/1

2. Computer program and Pascal

All computers, regardless of their sizes and shapes, are simply electronic machines that help us to solve problems by following instructions given to them. A set of **instructions** (指令) arranged in a suitable sequence to be executed in order to solve a problem is called a **program** (程序). A program to be executed by a computer is called a **computer program** (電腦程序). The process of designing and writing a program is called **programming** (程序設計).

A computer program must be written in a **language** that the computer "understands", otherwise, the computer cannot follow the instructions. To suit different applications, there are many different languages used in writing programs. These include **FORTRAN** (used mainly in scientific research), **COBOL** (used in commercial sectors), **PROLOG** (used in artificial intelligence) and many others. In this course, we shall learn **Pascal**, which is a language understood by most microcomputers (as well as many minicomputers).

Pascal is a general purpose programming language originally designed by Professor Niklaus Wirth of the Technical University of Zurich, Switzerland and named in honour of Blaise Pascal, the famous French Seventeenth Century philosopher and mathematician. The language was designed for introducing **structured programming** and **data structure**

3. Meet the microcomputer hardware

Fig. 1.3 shows a microcomputer: the IBM PS/1.

Let us take a look at the **hardware** (硬件), i.e. the physical parts of a microcomputer system. A typical microcomputer system consists of a **circuit board** (電路版), a **visual display unit (VDU)** (直觀顯示部件), a **keyboard** (鍵盤), a **mouse** (鼠形光標操縱器), a **disk drive** (磁盤機), a **hard disk** (硬磁盤) and a **printer** (打印機).

The circuit board (Fig. 1.4) consists of many **integrated circuit chips** (集成電路晶片) and many electrical components (such as capacitors and resistors). These chips include the **microprocessor** (微處理器), the **RAM** chips and the **ROM** chips.

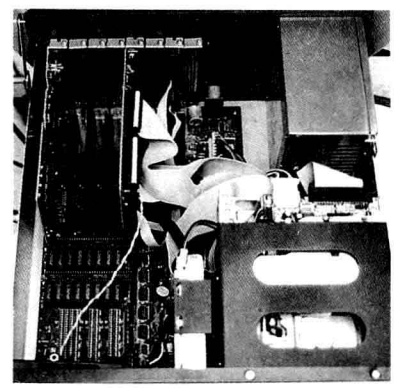


Fig. 1.4 The circuit board of an IBM computer

The microprocessor, also known as the **central processing unit (CPU)** (中央處理器), is responsible for the arithmetic and logic computations and the overall control of the computer. It serves as the "brain" of the computer.

The RAM (**Random Access Memory**) (隨機存取存貯器) chips are used for storing user's programs and data.

The ROM (**Read Only Memory**) (只讀存貯器) chips are used for storing vital programs, for instance, those needed to start the computer working.

The VDU, also called the **monitor** (監視器), is an output device where results of processing are displayed.

The keyboard (Fig. 1.5) is an input device used for entering programs, commands and data.

Besides using a keyboard, a mouse (Fig. 1.6) is another kind of input device. You can use it to point to an item you want to select on the VDU and then select the item by clicking the mouse.

There are typically two buttons in a mouse. At the base of the mouse, there is a mechanical tracking ball. When the mouse slides on a smooth surface, the tracking ball moves too and the movement of the tracking ball controls the movement of the pointer on the screen. In QuickPascal, the pointer looks like a rectangle. The following are the terms and the corresponding meaning in using a mouse:

Term	**Meaning**
Click	To press and release the mouse button quickly.
Double-click	To click the mouse button twice in rapid succession.
Drag	To move the mouse while you are holding down the mouse button.
Point	To move the mouse until the mouse pointer on the screen points at a specific item.

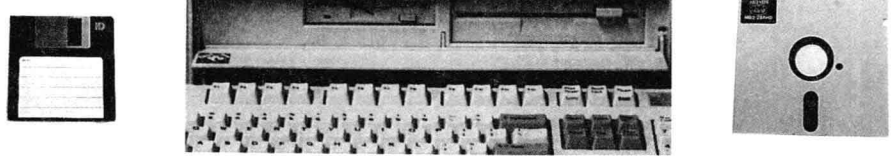
Fig. 1.5 A keyboard

Fig. 1.6 A mouse

The disk drive does the read/write operations on **floppy disks** (軟磁盤) (Fig. 1.7). A floppy disk is a secondary storage medium used for storing programs and data. There are two types of disk drive:

(i) 3.5-inch disk drive (which can read/write 1.44MB and 720KB floppy disks);
(ii) 5.25-inch disk drive (which can read/write 1.2MB and 360KB floppy disks);

A 3.5-inch disk drive **A 5.25-inch disk drive**



A 3.5-inch floppy disk **A 5.25-inch floppy disk**

Fig. 1.7

As the cost for storage media is decreasing, most people prefer to use hard disk (Fig. 1.8) as the storage medium. They are made of hard metal. The magnetic spots on a hard disk surface are denser than those on a floppy disk and thus can store more programs and data.

In addition to these, many computer systems are equipped with a printer (Fig. 1.9) connected to the CPU. A printer can print the programs or results of processing on paper.

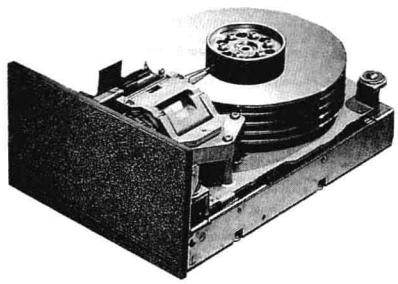


Fig. 1.8 A hard disk

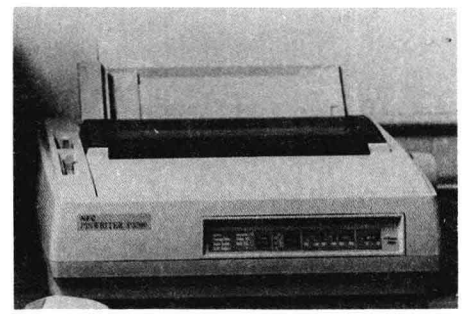


Fig. 1.9 A printer

4. Knowing your keyboard

Look at the keyboard. You will find the keys marked "A" to "Z". If you press these keys, the corresponding letters will appear in lowercase (small letter) on the screen. If you want to have a letter in uppercase (capital letter), you should press the Shift key first and, while not releasing it, press the key of the letter you want. If you want to have all the letters in uppercase, you may simply press the Caps Lock key beforehand. If you want to have the small letters again, you may press the Caps Lock key again. The key Caps Lock serves as a switch for switching on or off the capital letters. Some of the keys, eg. ! i , have two symbols marked on it. If you press these keys alone, the lower symbols will appear on the screen. Now suppose you want to type the symbol "!", you should press the ! i key while you are pressing the Shift key.

On the keyboard, you should be able to find the Enter key. Whenever you have finished typing a line of command or data, you should press the Enter key to tell the computer that the line ends there.

The two keys ← and → are used to move the **cursor** (光標) (i.e. the flashing line on the screen which indicates where the next character you type will appear) in the direction indicated on the key. You may also find another ← key next to the \ key. This ← key is used to erase the previous character. In addition, there are two keys marked "Insert" and "Delete". If you want to insert any character, you should move the cursor to the appropriate position and then press the Insert key. The characters you type will be inserted. If you want to delete any character, you should move the cursor to the position of the character you want to delete and then press the Delete key. You may use these keys to correct any typing mistake before pressing Enter.

5. A look at the floppy disk

After writing the programs, you would like to store your programs so that you need not type them every time you use them. Probably, you will store your programs on floppy disks. Let us take a look at a floppy disk.

A floppy disk (or a **diskette**) is basically an annular piece of plastic material. It is coated with a layer of magnetic oxide so that the read/write head of the disk drive may record information on its surface magnetically (just like a recorder recording music on a cassette tape). When it is placed inside the disk drive, it may be set spinning so that the read/write head can reach the appropriate position on the surface of the floppy disk. The surface of the floppy disk is protected from dust by a protective jacket.

In Fig. 1.10 you can find the following features of a 5.25-inch floppy disk:

(1) A central hole — a hole at the centre to allow the insertion of a spindle in the disk drive to set it spinning.

(2) A read/write opening — an opening to enable the read/write head of the disk drive to read or record data or programs on the disk.

(3) An index hole — to facilitate the searching of data or programs on the floppy disk.

(4) A write-protection notch — if it is covered by an opaque sticker, the programs and the data on the floppy disk will be protected from being over-written by the disk drive.

(5) A manufacturer's label — a label which shows the brand name and the type of the floppy disk.

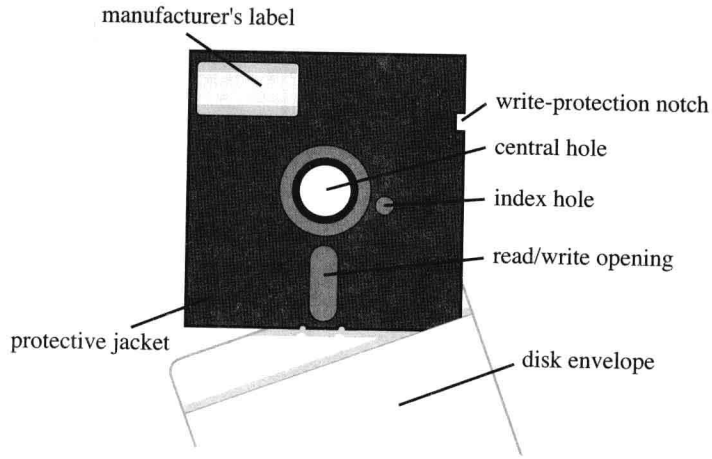


Fig. 1.10 Features of a 5.25 inch floppy disk

Precautions: (see Fig. 1.11)

(1) Always put the floppy disk inside its envelope when not in use.

(2) Never touch the read/write opening of the floppy disk. Always hold it gently only on the side of the manufacturer's label.

(3) Prevent dust and moisture from falling onto the surface of the floppy disk.

(4) Do not put floppy disks near magnets.

(5) Do not expose floppy disks to sunshine. They should be kept under temperature of 10°C to 52°C and relative humidity of 8% to 90%.

(6) Do not write directly on the floppy disk surface.

(7) Do not twist or bend a floppy disk.

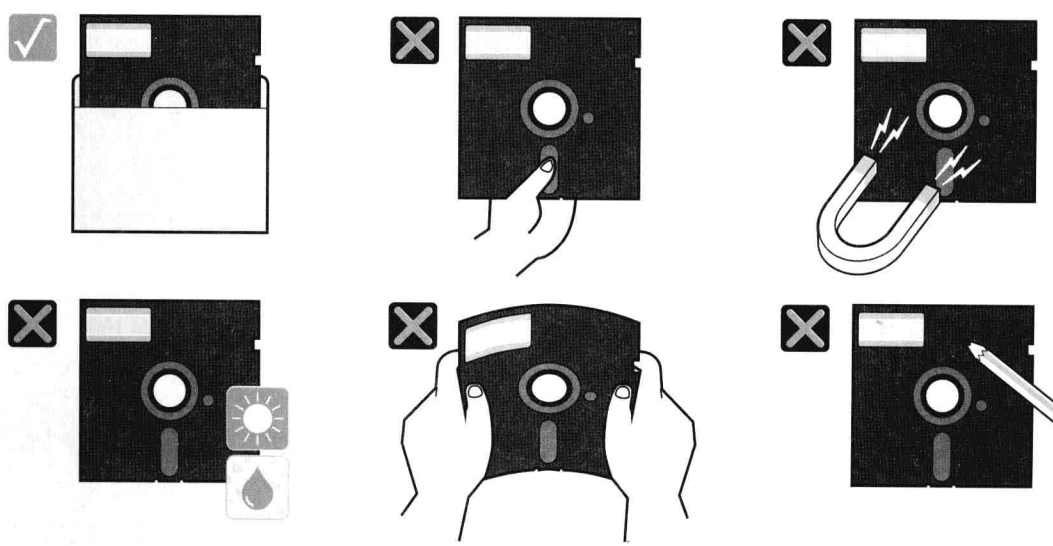


Fig. 1.11

Unlike a 5.25-inch floppy disk, the read/write opening of a 3.5-inch floppy disk is protected by the shutter. Do not move the shutter and contact the read/write opening of the floppy disk. There is a write protect tab on the floppy disk. You can protect the floppy disk from being written simply by shifting the write protect tab to the safe protection position indicated in Fig. 1.12.

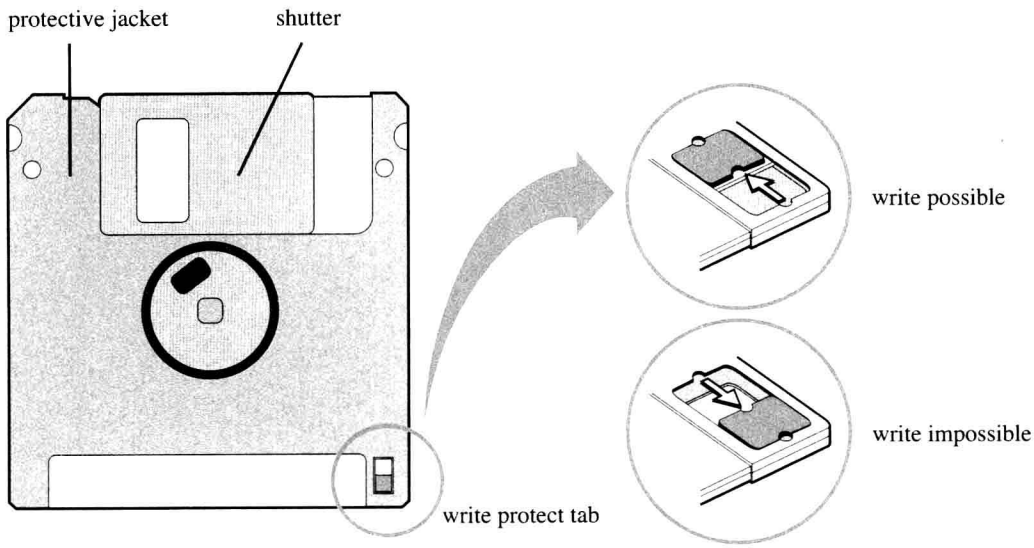


Fig. 1.12 A 3.5-inch floppy disk