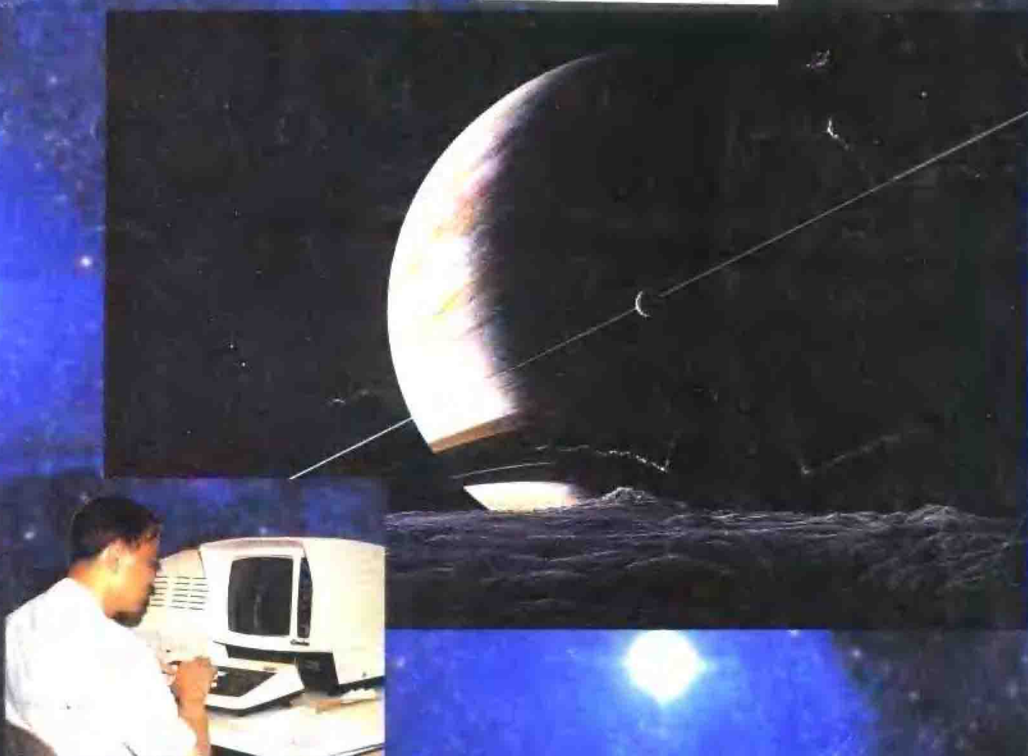
# 计算机专业英语

何兆枢　战守义　龚元明　编著



海洋出版社

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# 前　言

在多年从事计算机专业英语的教学工作中，我们深刻地认识到，计算机技术发展是如此迅速，以至计算机专业英语的教材需要不断地更新，不断地补充一些新内容，才能满足大专院校的学生以及广大工程技术人员学习计算机专业英语的需要。

本书是用英语编写的计算机专业英语课程教材，内容涉及计算机硬件、软件和应用诸方面，包括计算机体系结构、新产品、新设计、操作系统、软件工程、编译原理、C、C++、Turbo C++ 和 LISP 简介、计算机网络和通讯、计算机翻译、计算机建筑设计、计算机天气预报、计算机控制、机器人、数据库、计算机教学以及人工智能、专家系统、计算机视觉、计算机仿真、数字图像处理和虚拟现实技术等反映 90 年代计算机技术最新发展的题材。

全书共 32 课，适用于大专院校计算机专业英语课程 60～70 学时的教学计划。每课除课文之外，还提供词汇表、阅读理解提问及注释。本书可以作为大专院校计算机专业高年级学生学习专业英语的教材，也可以作为科技人员学习计算机专业英语的参考书。毫无疑问，本书将有助于读者增长专业知识并提高阅读英语计算机科技文献的能力和水平。

本书作者，敬请广大读者及学界不吝赐教。

北京理工大学计算机系
何兆枢　战守义　龚元明
1997 年 6 月

# CONTENTS

# Lesson One
# The Basic Structure of Computers

A digital computer of Von Neumann type, however complicated, can be divided into 4 basic units: the input/output unit, the arithmetic unit, the control unit and the memory unit.

### The Input/output Unit

The input/output unit is an equipment to read the information and the computer instructions into the machine (the input) and to print or display the results of the computation (the output). Many types of devices are available to perform these tasks, for example, teletypewriter, card readers, line printers, magnetic tape readers and CRT terminals[1].

Usually, the rate of processing information in the arithmetic unit is much faster than that in either the input or output equipment. This is primarily because the input/output units usually involve some mechanical operations, whereas the internal calculations proceed at electronic speeds. This speed difference is not critical if the information required of the problem and the results are small compared with the amount of calculation. This is the case in many scientific calculations, where the input/output equipment may be rather slow without causing a great unbalance between input and output time versus computing time. However, in data processing and many business problems, a considerable amount of information must pass through both the input and output equipment with relatively little computing done on the data. In this case, the speed of the input/output equipment is quite critical.

An expedient can be using slower circuits for computation, resulting in a slower overall speed. Tracing the development history of computer hardware, we can see a remarkable trend, that is, more and more sophisticated input/output equipment and logical organization of these units have been proposed to maintain a reasonable balance between computing time and input/output time, without any possible conflict that occurs during operations. But there is the rub. With the ever-growing request for fast speeds, the internal computative abilities have become so fast that rather sophisticated input/output equipment is required even for problems having relatively little input or output operation. As an alternative, the organization of computer equipment is made to allow input and output operations to proceed without stopping internal computation. For example, the computer system might be printing the results of one problem on a line printer while doing computing on a second problem and at the same time reading in information and instructions for a third problem from a CRT terminal. It is obvious that such an organization of operations in a computer becomes rather complex, since it must take into account any possible conflict and competition for computer resources that would occur among all units. A sophisticated operating system can ensure that such chaos does not occur among all the various user processes and correct arrangement of operating order and distribution among units of computer resources such as the CPU, ALU and input/output equipment are automatically handled, and that the information needed for computations is available whenever it is called for.

Governed by such an operating system, each input/output equipment can work separately from the mainframe durnig most of the time or stays idle until an inquiry signal comes from the CPU, and joins in the system once it is activated by a trigger signal.

Today, input/output equipment has been diversified and specialised in its functions. Laser hard copiers, graph printers, video/audio terminals and artificial intelligent interfaces continue to expands the arsenal of input/output equipment.

### The Arithmetic Unit

The arithmetic unit performs the calculations on the numbers and words in the computer. The main operations are addition, subtraction, multiplication and division. Most computers can also perform certain logical operations on words.

The way in which arithmetic operations are performed and the method of representing numbers in the computer[2] have a great effect on the computer's architecture. A classification of arithmetic units is commonly made as to whether the arithmetic unit acts on single digits at a time (serial mode) or upon all the digits simultaneously (parallel mode). A serial mode of operation requires less equipment than a parallel mode since the digits are sequenced through the same circuits one after another; but of course, it takes more time for a certain operation. Serial operation has become popular for medium and small size computers because they need less investment and the input/output operations can be performed concurrently with internal computations if serial input/output equipment such as magnetic tape-readers and teletypewriters is used. In the parallel mode, all digits are treated simultaneously. It needs more space to transfer and store data, but results in faster speed. Magnetic core memory units and magnetic disks are usually used to combine with a parallel arithmetic unit because they can read in a complete word of information at one stroke.

Many variations of number representations are found in today's computers. The determining factors are the base used, the precision (or length of word), the range of numbers, floating or fixed point, and the type of negative number representation. Usually, either a binary or a decimal base is used in computers. Decimal numbers are represented by some sort of variations of binary encoding.[3]

The introduction of binary system into computers associates with the fact that scientists have so far developed the most effective digital circuits that have two states, one being called "one" (or "on"), and the other "zero" (or "off"). In binary language, any number can be represented using only the numbers 0 and 1. Obviously, binary numbers require a longer sequence of digits than their decimal equivalents. To accommodate a binary number, registers, buses, memory units and ports which the computer needs have more digits than those for decimal numbers. However, arithmetic operations and logical operations on binary numbers can be much simpler and needs much less computer time than in a decimal system.

Commonly known as the ALU, an acronym for Arithmetic-Logic Unit, arithmetic units today are IC (Integrated Circuit) products concealed in a single package for each. Among their diverse specifications, the existing arithmetic units are 8-bit, 16-bit, and 32-bit. For some sophisticated computers, a 64-bit arithmetic unit suggests that its least significant digit corresponds to a precision of the 63rd power of 2, a very small value as we can hardly imagine it

### The Control Unit

Early computers did not possess a control unit as we know it in today's computers. The control was done either by looping the operations in punched tape or by wiring of a plugboard to indicate the operation sequence instead of executing instructions as we now write them in programs.

A new concept of operation arose in the early 1950s, in which the instructions as well as the numbers to be treated were stored in the memory unit. This is called the stored program computer, which enables the sequence of operations to be modified easily in the ALU in just the same way as numbers are treated, thereby giving great flexibility to sequencing operations.

The first phase of control is to provide signals to activate the operations in the ALU, the memory unit and the input/output units. After completing an instruction, the control calls for the next instruction from the memory unit. Usually, the instructions are stored in an increasing order of address. An instruction counter is used in the control unit to record the address of the instruction under examination. By incrementing the address counter, the control unit turns to the next instruction to be fetched.

Special instructions called transfer instructions are used when the control needs to leave the current loop of operations and turn to another set of instructions. Among them, the unconditional transfer instruction always causes a modification done to the instruction counter while the censitonal transfer instruction may cause different types of modifications depending on the result of some previous calculations specified in the program.

After an instruction is fetched, its operation code is decoded to produce a signal which is then sent to a proper unit and the operation can begin. The operand can be found by following the address called "original address". The result of this operation is sent to the cell indicated by the "destination address".

To keep the system working at a unanimous pace, the control unit must schedule all units with synchronous pulses under the charge of a central timing unit—a crystal clock built inside it. Frequence multiplication and frequence division help produce sequences of pulses with different repetitive frequences used for different rhythms. These pulses are transmitted to working units, used as strobe pulse or trigger pulse in various synchronous modes.[4]

In fact, the job which the control unit takes is far more complex than is described above. We can imagine it as the conductor of a symphonic orchestra. He/She reads the notes one by one from the score and tries to understand immediately what the composer intends to describe in his/her notes, and then conducts all musicians to play their individual instruments following exactly the notes assigned to every one. Every instrument must be played and stopped all at the right moment and the orchestra must be organized strictly under the guidance of the conductor.

The control units and the ALU today are IC products known as the CPU (Central Processing Unit). Every manufacturer has developed various types of CPU for building computers of different architectures. In some sophisticated computers, multiple CPU 's are used, each assigned to a specific mission for local control, with a master CPU playing the role of global control.

**The Memory Unit**

The memory unit is used to store information which includes input program and data, intermediate results of computation, final results to be transmitted to output units. Many computers today have their system software and utility files stored in their memory units ready for immediate use.

The memory unit is organized on the basis of "word". Each word can be stored with an address code and in a certain number of bytes and each byte is further divided into certain number of bits. The bit, as the smallest unit in a binary system, can have a value of either 1 or 0.

A memory unit is composed of millions or even billions of magnetic cells organized in a 3-dimensional array. To store 1 or 0, a magnetic cell is magnetized in one direction or the other by its "write" current. To retrieve the information stored, an inverse "read"current is needed.

In the past decades, the most popular memory unit was the magnetic core memory device working in a parallel fashion, that is, all the bits of a word were written or read simultaneously. Semiconductor memory devices are now used as the internal (main) storage unit. The advantage is obvious: high working speed, small volume, and little weight. But information stored in it will lose when power supply is interrupted. Semiconductor memory devices are now popular. Coupled with other types of storage devices, for instance, magnetic disks and tapes which are commonly used as the external(auxiliary) storage devices, they, commonly known as the RAM (Random Access Memory), are widely used in today's computers, large and small. ROM (Read Only Memory) is another type of semiconductor device used for permanent storage of information. A newly developed storage device called the Compact Disk (CD) is made of special liquid crystals of plastics used as the medium for storing information. A laser beam is used as a "working head" to read and write information. Its advantages include high density of storage (hence great capacity of storage), high working speed, long service life and flexible application. It can be used as RAM, ROM, EPROM (Electrically Programmable Read Only Memory) for storing information of almost all kinds.

**Notes: Major parts of a personal computer**

1. Central processing unit (CPU): The CPU is the major part of a personal computer. Intel and Motorola are the two giants of chip manufacturers in the world. Each of their CPU chips has ushered in a new product series of PCs. IBM has brought to market its PC products based on Intel 's powerful microprocessors 80 × 86 series since August, 1981. Apple first made its PCs based on Motorola's 68000 series as CPUs, now it introduces Power Macintosh series based on the PowerPC chip (an RISC chip created jointly by IBM, Motorola and Apple), which is said to be 10 times faster than a normal 80486- or 68040-based PC. Intel is mass-producing Pentium in 90 MHz version and will soon 100 MHz version. Pentium, having 3 million transistors,

is by far the fastest microprocessor which can crunch 170 millions of instructions per second. Intel also added a new member to its 486 family, the DX4 chips in version of 75 and 100 MHz. Intel is expected to have its P6 microprocessors ready for mass production by June, 1995, which with 6 million transistors, has two to three times more performances than Pentium. Following Intel's introduction of its new DX4 and faster versions of the Pentium chips, microcomputer manufacturers have come out with systems based on these microprocessors as CPUs. PC systems that utilize the 75 MHz DX4 chip include two notebooks, the Compaq LTE Elite and Texas Instrument's TravelMate 4000E WinDX4/75; AST's new Bravo LC 4/100t is based on the 100 MHz DX4 chip. Hewlett-Packard announced the most powerful PCs, the Vectra XU series based on Pentium 90 MHz or 100 MHz. This is in addition to its new DX4, 100 MHz Vectra VL2 4/100 PCs.

2. RAM and ROM: The RAM in a personal computer is used as the main (internal/immediate) storage for programs and data which the CPU reads/writes. The basic requirements of RAM include high working speed and large capacity. As the CPU frequently accesses the RAM, the access time is a major factor that has great influence on the overall working speed of the computer. The amount of RAM in a computer is measured in terms of bytes. Most modern PCs come with at least 640K bytes of RAM—the largest amount of RAM that the MS-DOS operating system allows a program to use. Many of today's powerful programs that handle large quantities of data are bumping up against this 640K limitation. For this reason, today, 1000K and 2000K RAM are common. In 1985, Lotus, Intel and Microsoft announced Expanded Memory Specification version 3.0 (LIM EMS 3.0). Software programs written for EMS 3.0 could use up to 8 megabytes of RAM, although only 64K of this expanded memory could be active at a time. With EMS 3.0 therefore data had to be clearly divisible into 64K chunks so that it could be easily swapped in and out of active memory. AST Research then came out with an enhanced EMS (or EEMS) standard which provided access to 16 megabytes of RAM and allowed for 1 megabyte of active memory. Finally in 1987 the Lotus/Intel/Microsoft team upgraded their EMS to version 4.0. EMS 4.0(or LIM 4.0)allows access to 32 megabytes of RAM. The computer industry continues to improve its ability to make use of more and more RAM. Today, the largest RAM, which has an area of only 286 square millimeter, has a capacity of 256 MB, a capacity large enough to store 250 000 pages of text, and an access time of only 26 nanosecond. It is the product developed by an joint research of IBM, Toshiba and Siemens for two and a half years.

The ROM is reserved for certain very important programs necessary to the operation of the machine, for example, programs for testing the operations of various components of the computer. ROMs are fitted in the machine at the factory and the user cannot change them.

3. Hard disks: A hard disk (or fixed disk), also called a Winchester disk, stores information on a hard platter that is sealed within either the drive unit itself or a hard plastic cartridge. It is not generally removeable. The storage is made on a magnetic storage medium in the form of one or

more circular platters (the size varies) that rotate within a sealed enclosure. Not only do fixed disks hold much more data than do diskettes, but they rotate much more rapidly than diskettes, allowing the computer to access their data much more rapidly.

In recent years, the price of fixed disks has plunged and they have become very common equipment on personal computers. As programs for personal computers have become more complex, a hard disk has become almost a necessity, unless the user is willing to put up with continually swapping diskettes.

Just like a diskette, a hard disk's platters are organized into tracks and sectors. Information is written on the platters in a process called formatting. Usually, hard disks that are sold as part of a computer system are already formatted and the user will never need to worry about formatting them unless it becomes necessary to reinitialize the disk (a rare event).

The capacity of a hard disk varies from 160 MB to 2GB

4. Diskette drives: There are one or more than one diskette drives in a personal computer. A diskette drive reads and writes information on diskettes, used for program and data storage. Diskettes resemble phonograph records; they are often called "floppy disks" since the oldest types of diskettes were flexible. A diskette can hold anywhere from 360 KB to 1.44 MB, depending on the type of diskette. The floppy diskette drives are important for loading new software onto the hard disk, and for backing up the contents of the hard disk. There are broad categories of diskette drives: those that use 5.25-inch diskettes are floppy diskettes, whereas the 3.5-inch diskettes are made with a rigid plastic jacket. Within each category, there are low-density and high-density diskettes. For 5.25-inch diskettes, a low-density diskette (also called a double density diskette) can hold 360KB; a high-density 5.25-inch diskette can hold 1.2 megabytes. A low-density 3.5-inch diskette holds 720KB and a hgih-density 3.5-inch diskette holds 1.44 magabytes.

A diskette is divided into a number of concertric circles called tracks. A diskette is typically divided into a few hundred tracks per surface. Each drive has a movable head that can be moved closer to or farther from the center. The head is wide enough to read or write information from exactly one track. The radial position of the head (distance from the spindle) is called the cylinder address. Tracks are divided further into sectors, normally between 10 and 100 sectors per track. A sector consists of a certain number of machine words, typically 32 to 256. On some diskettes, the number of sectors per track can be set by the program.

5. The video portion of a personal computer system consists of two parts: the monitor itself and a circuit board, called a video adaptor, which sends the appropriate signals from the computer to the computer's monitor. The video adapter is most often inserted into one of the so-called expansion slots located within the case of the computer. (A few personal computers have the video adapter built into the main circuit board.) The video capabilities of the system include the resolution (sharpness) of the screen and the colors that the system can display. These capabilities are determined both by the user's choice of display adapter and monitor.

The simplest and oldest video adapters are the monochrome display adaptor (MDA) and the color graphics adaptor (CGA). The monochrome display adapter allows the user to display a single color on a monochrome monitor and does not allow display of any graphics. The color adaptor allows the user to display up to four colors simultaneously on a color monitor and allows to display graphics with a resolution of 320 × 200 in four colors or 640 × 200 in two colors (black and white).

The newer and more typical video adaptors found on today's PCs include the following:

Hercules—720 × 348 graphics on a monochrome monitor;

Enhanced Graphics Adapter (EGA)—640 × 480 graphics in 16 colors on an EGA color monitor or a 640 × 400 graphics in two colors on a monochrome monitor;

Video Graphics Array (VGA) —up to 640 × 480 graphics in 16 colors or 320 × 200 in 256 colors on a VGA monitor.

6. Serial and parallel adapters: There are hundreds of different devices that can be connected to a personal computer, ranging from pointing devices (mice) to printers, from scanners to communication devices (e.g. modems and fax machines). There are two general-purpose ways of connecting such devices to a computer, namely via either a serial adapter or a parallel adapter. Each of these adapters has an outlet or plug, into which the user can insert the appropriate cable from the printer or other devices. Most modern personal computers come with at least one built-in serial adapter (also called a serial port) and one built-in parallel adapter (also called a parallel port). Parallel ports are designed primarily for printers. Serial ports are most often used for printers and modems; serial ports send data one bit at a time, or serially, resulting in slower transmission rate. In configurations requiring connection of many devices, it is necessary to equip the computer with multiple parallel and/or serial ports or a switching box to permit different devices used one at a time to be connected to the port.

7. Printers: Printer technology has progressed rapidly in the last decade. There are two basic types of printers:

Dot-matrix printers. These printers print letters as a collection of dots created by a set of wires or pins impacting on a ribbon. The most important distinguishing characteristics among these are the printing speed and the number of dots it takes to form a character (resolution).

Laser printers. These printers, the most expensive, combine high-quality printing with great speed. A laser printer can produce from eight to more than 50 pages a minute. The print quality rivals or equals that of typeset text (depending on the printer's resolution).

Laser printers have made possible the field of desktop publishing in which personal computers are used to design and typeset written material, which formerly was the exclusive domain of publishers.

The printer must be connected to the system unit. The exact nature of this connection will depend on the printer. Some printers are equipped with a parallel interface and some with a serial interface. For a parallel interface, you must connect the printer to a parallel printer adapter;

for a serial interface, —to a serial adapter.

8. Keyboard.

## 注释

[1] teletypewriter (又称为 teleprinter) 电传打字机，是用于电报和计算机输入输出的一种终端设备，通过手动按钮输入能产生相应的输出。输出方式包括发出电码、在纸上打印字符和输出穿孔纸带等。这种设备目前已很少使用。

Card reader 卡片阅读机，作为一种输入设备，用于早期的计算机中，能检测出卡片上的小孔并且能转换成机器代码。

line printer 行式打印机，是当前计算机常用的输出设备。它把计算机输出信息的编码转换成为字符形式并且印成硬拷贝，以供用户阅读和保存。

magnetic tape readers 磁带阅读机，它将磁带上记录的信息转换成为一串电脉冲的设备，通常作为计算机的输入设备。

CRT terminals CRT 是 Cathode-ray tube 阴极射线管的缩写。CRT terminal 是阴极射线管终端，又称为视频数据终端。它是当前计算机使用最普遍，也是最重要的输出显示设备。

[2] the method of representing numbers in the computer 数字(整数、实数)在计算机中通常用二进制表示，最高位往往是符号位，"0"表示正，"1"表示负。每 8 个二进制位称为一个字节，不同计算机表示数据范围大小也不同，通常用 2 个、4 个或 8 个字节来表示一个数字(又称为 16 位、32 位或 64 位计算机)。

数字在计算机中有不同的编码方式，主要为方便各种计算，常有原码、反码和补码三种形式。

由于二进制难以被人所理解和记忆，因此用户往往以十进制方式输入数字，计算机自动把它转换为二进制，然后在计算机内部存储和运算，其运算结果也是二进制，最后计算机再自动把运算结果转换为十进制，通过显示屏幕或者打印机告诉用户。

[3] binary encoding 二进制编码，指用二进制编码来表示十进制数字的方法，目前常使用二－十进制编码(BCD 码——binary-coded decimal)即用若干二进制表示一位十进制数的方法，表示的方法很多，例如，8-4-2-1 码，5-4-2-1 码、2-4-2-1 余 3 码等。在 8-4-2-1 码中，十进制和二-十进制数间关系如下：

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 十进制 | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| 二-十进制 | 0000 | 0001 | 0010 | 0011 | 0100 | 0101 | 0110 | 0111 | 1000 | 1001 |

[4] various synchronous modes 多种同步方式

在计算机中，各工作单元的工作必须进行同步，计算机中每一个事件或操作均由统一的时钟信号所启动和控制，例如在计算机中数据传输时必须使发送速度和接收速度保持一致或使几个时标信号之间保持固定的时间关系等。例如，在指令控制中，控制器用三种方式来进行同步控制：一种是顺序方式。执行完 一条指令后方可取下一条指令来执行，这种方式同步控制简单，但速度慢，机器各部件利用率低；第二种是重叠控制方式，在一条指令执行的同时，取出下一条指令以加快速度(但单条指令执行时间不变)，这种方式适合于顺序执行指令，遇到转移指令就无能为力；第三种方式是流水方式，是更高速度上的重叠。把一个复杂过程分为 m 个复杂程度相当、处理时间大致相等的子过程，每个子过程由独立部件完成，像生产流水线一样工作，能最大限度地提高运行效率。

## Words and Phrases

digital ['didʒitl] *a*. 数字的

teletypewriter ['telitaip'raitə] *n*. 电传打字机

CRT (Cathod Rays Tube) *n*. *phr*. 阴级射线管

terminal ['tə:minl] *n*. (计算机系统)终端(机)
whereas [ *h* wɛər'æz ] *conj*. 而,却,反
proceed [prə'si:d] *vi*. 继续进行
critical ['kritikəs] *a*. 关键的
versus ['və:səs] *prep*. 对
expedient [eks'pi:djənt] *n*. 权宜之计
sophisticated [sə'fistikeitid] *a*. 复杂的,高级的
There is the rub *phr*. 难就难在这里
operating system [ˌɔpə'reitiŋ 'sistəm] *n*. 操作系统
CPU (Central Processing Unit) *n*. *phr* 2 中央处理器
ALU (Arithmetic Logic Unit) *n*. *phr* 算术逻辑单元
mainframe ['meinfreim] *n*. 计算机系统的主机
activate ['æktiveit] *vt*. 开动,使动作起来
trigger signal ['trigə'signəl] *n*. *phr* 触发信号
artificial intelligent interface *n*. *phr* 人工智能接口
addition [æ'diʃən] *n*. 加法
subtraction [səb'trækʃən] *n*. 减法
multiplication ['mʌltipli'keiʃən] *n*. 乘法
division [di'viʒən] *n*. 除法
architecture ['ɑ:kitektʃə] *n*. 结构,构造
serial mode *n*. *phr* 串行型
parallel mode *m*. *phr* 并行型
concurrently [kən'kʌrəntli] *adv*. 同时地,并发地
simultaneously [simʌl'teinjəsli] *adv*. 同时地
stroke [strəuk] *n*. 一下(子),一击,
variation [ˌværi'eiʃən] *n*. 变种,变异
base [beis] *n*. (数学上的)基数
precision [pri'siʒən] *n*. 精确度
floating point *n*. *phr*. 浮点
fixed point *n*. *phr* 定点
decimal ['desiməl] *a*. 十进制的
binary ['bainəri] *a*. 二进制的
equivalent [i'kwivələnt] *n*. 对等物
port [pɔ:t] *n*. 通道,端口
acronym ['ækrənim] *n*. 同义词
integrated circuit ['intigreitid] *n*. *phr* 集成电路
conceal [kən'si:l] *vt*. 封闭,封装
least significant digit *n*. *phr*. 最低位
power ['pauə] *n*. 幂
loop [lu:p] *n*. 循环
punch [pʌntʃ] *vt*. (纸带、卡片等)空孔
plugboard ['plʌgbɔ:d] *n*. 接线板
execute ['eksikjut] *vt*. 执行
instruction [in'strʌkʃən] *n*. 指示,指令
modify ['mɔdifai] *vt*. 修改
flexibility [ˌfleksi'biliti] *n*. 灵活性
phase [feis] *n*. 阶段,步骤
increment ['inkimənt, 'inkriment] *n*. *vt*. 增加
decode [di'kəud] *vt*. 译码
original address *n*. *phr* 起始地址
destination address *n*. *phr* 目的地址
unanimous [ju'nænimәs] *a*. 全体一致的
synchronous ['siŋkrənəs] *a*. 同步的
pulse [pʌls] *n*. 脉冲
frequence multiplication *n*. *phr*. 倍频(技术)
frequence division *n*. *phr*. 分频(技术)
repetitive [ri'petitiv] *a*. 重复的
rhythm ['riðəm] *n*. 节律
strobe pulse [strəub] *n*. *phr*. 选通脉冲
symphonic orchestra [sim'fəunik 'ɔ:kistrə] *n*. 交响乐管弦乐队
score [skɔ:] *n*. 总谱
note [nəut] *n*. 音符
mission ['miʃən] *n*. 使命,任务
intermediate [ˌintə'mi:djət] *a*. 中间的
utility [ju'tiliti] *n*. 公用
byte [bait] *n*. 字节
bit [bit] *n*. 位
retrieve [ri'tri:v] *vt*. 检索
inverse [in'və:s] *a*. 反向的,反的
interrupt [ˌintə'rʌpt] *vt*. 中断

auxiliary [ə:gziliəri] *a*. 辅助的

RAM (Random Access Memory) *n.phr*. 随机储存器

ROM (Read Only Memory) *n.phr*. 只读储存器

compact disk (CD) ['kɔmpækt disk] *n*. 高密度光盘

liquid crystal ['likwid 'kristəl] *n*. 液晶

medium ['mi:djəm] *n*. 媒介,媒体

laser ['leisə] *n*. 激光

beam [bi:m] *n*. (光)束

EPROM (Erasible Programmable Read Only Memory) *n.phr*. 可擦可编程只读储存器

## Comprehension Questions

1. Describe the functions of the input/output unit of a Neumann - type digital computer.
2. What major problems are involved in the input/output unit? How can these problems be solved?
3. What input/output equipment is usually used in present computers? Cite at least two examples for each.
4. Describe the functions of the arithmetic unit. Explain the "serial mode" and the "parallel mode".
5. Explain the way numbers are represented (positive and negative') in digital computers. Compare the decimal system and the binary system.
6. What is the ALU? Explain the significance of the precision of an ALU.
7. Describe the work of the control unit. Explain how the control unit keeps all units in the whole computer working at a unanimous pace.
8. What is the CPU? Tell what you know about the CPU products available in markets today.
9. How is a memory unit organized in a digital computer? Describe the memory unit in a PC and in a large and medium computers respectively.
10. Explain the work of various types of storage devices widely used in today's computers.

# Lesson Two
# New structures of Computers

## The Von Neumann Bottleneck Problem

Despite that great improvements and achievements have been made in computer hardware, computers today remain constructed with the traditional Von Neumann architecture as shown in Fig. 1. We have learned the configuration and operation of the four basic units in the previous lesson. We derive that the major problem of the Von Neumann architecture conflicting with the requirements of computers today lies in the continuous stream of memory access when a computer program is executed. Each instruction must be fetched from memory and decoded. Operands must be brought from memory into the ALU registers and the newly computed data stored back in memory. It turns out that computing speed is almost entirely determined by the memory access speed by the CPU. This limitation is generally referred to as the Von Neumann "bottleneck", as shown in Fig. 2.

A simple example is a simple program in the memory that adds two numbers stored at addresses 252 and 253 and stores the sum back in location 254. Here 's how it is done:

1. Control unit fetches the first instruction(LDA 252), stores it in the instruction register, and decodes it.

2. The first instruction is executed. It says to load the accmulator register with the data word at address 252. The number 19 is retrieved from memory and put into the accumulator.

3. The second instruction(ADD 253)is fetched, stored in the instruction register, and decoded.

4. The second instruction is executed. It says to add the number in address 253(38) to the one in the accumulator(19). This is done; the sum is stored in the accumulator.

5. The third instruction (STORE 254) is fetched, stored, and decoded.

6. The third instruction is executed. The number in the accumulator is transferred to memory location 254.

As you can see, even such a simple program requires six memory accesses. If each access takes 100 nanoseconds and the add operation takes 10 nanoseconds, the total execution time is 610 nanoseconds, of which only 10 nanoseconds or about 1.6% is for computation. The remaining 98.4% is for pure memory access.

Improving computer speed then requires much faster memories. Further, it requires changes in architecture that will permit multiple simultaneous rather than single accesses to the memory. Multiple memories[1] are another solution.