Storage Devices - Optical Disk

An optical disk is impressed with a series of spiral pits in a flat surface. A master disk is burnt by high-intensity laser beams in bit-patterns from which subsequent copies are formed which can be read optically by laser.

CD-ROM: CD-ROM (*compact disk read only memory*) is an optical disk storage that contains text, graphics and sound. CD-ROM can store around 650 MB of data. CD-ROM disk is almost the same as the music CD, but uses different forms of track for data. A CD-ROM drive can read music CD, but a CD player cannot read CD-ROM. CD-ROM is a *read-only* disk that cannot be written on or erased by the user.

WORM: A WORM (*write once, read many*) disk is an optical disk that written on just once by the user's environment and then cannot be overwritten. A WORM disk is ideal for use as archive because it can be read many times, but the data cannot be erased. The storage capacity of WORM disk ranges from 400 MB to 6.4 GB.

Erasable Optical Disks: This is an optical disk that can be erased and written on repeatedly. An erasable optical disk has a great deal of data capacity. It can store up to 4.6 GB. An erasable optical disk functions like a magnetic disk and has huge capacity, so it will replace the magnetic disk in the future.

how computer memory is measured: bit, byte, KB, MB, GB, TB.

Bits

In all the components of a computer, data and instructions are stored as patters of ones and zeros. These individual ones and zeros are called bits.
In electronic components the one is stored by switching an electronic switch on and a zero by switching it off. On a magnetic material, such as the surface of a hard disk, the one may be stored with a clockwise magnetic field and a zero with a counter-clockwise field.

Bytes

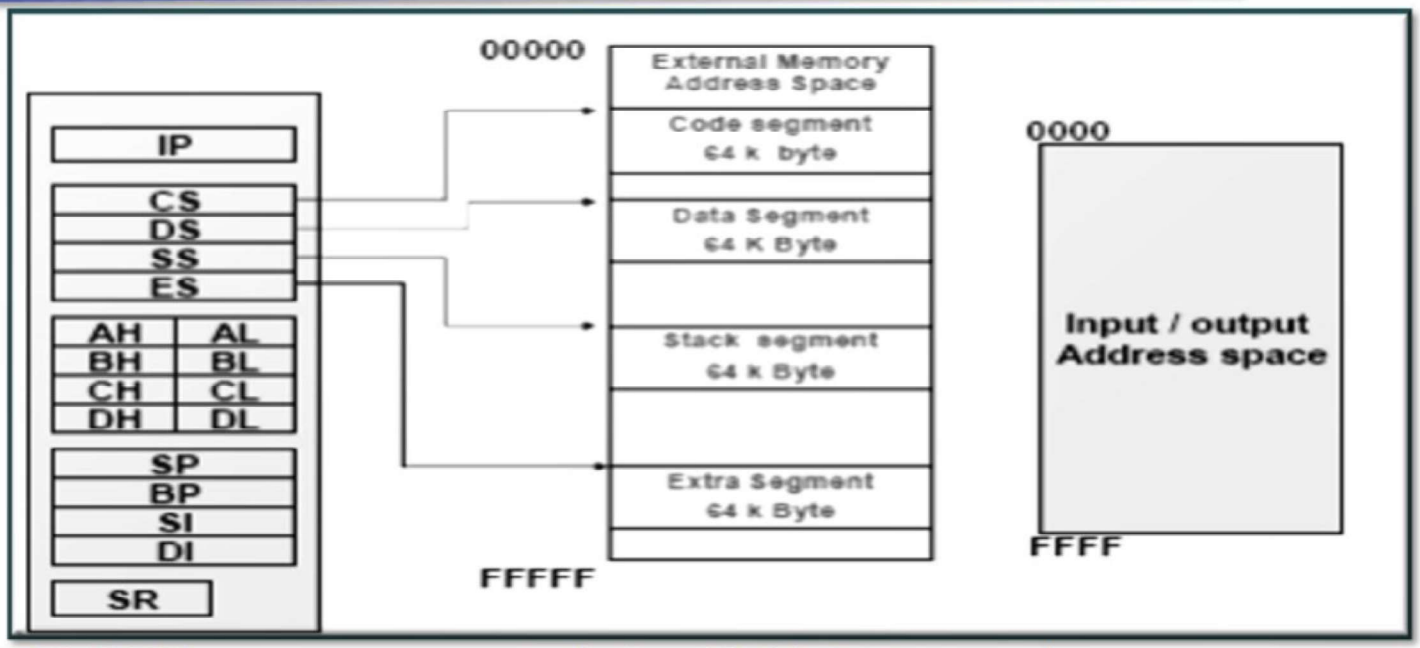
Bits are grouped together into sets of eight. A set of eight bits is called a **byte.**
ASCII or American Standard Code for Information Interchange was a system of representing all the characters of the western alphabet and certain special characters in a single byte. You can think of the byte as the amount of memory required to store a single character. As there are only 256 possible variations within eight bits, this is not sufficient to represent other alphabets. As a result a new system, called **uni-code, has been developed to represent all the** alphabets of the world. This makes use of two bytes. With two bytes, 65536 different characters and symbols can be represented.

Units of memory

kB	kilobyte	2^{10} = 1 024 bytes
Mb	Megabyte	2^{20} = 1 048 576 bytes
Gb	Gigabyte	2^{30} bytes
Tb	Terabyte	2^{40} bytes

- 8086, in 1978
  - First 16-bit microprocessor
  - 20-bit address bus, i.e. 2^{20} = 1MB memory
  - First pipelined microprocessor
- 8088
  - Data bus: 16-bit internal, 8-bit external
- 80286, 80386, 80486
  - Real/protected modes
  - Virtual memory

Software Model of the 8086 Microprocessor



- 8088/8086 microprocessor includes 13 16-bit internal registers:
  - Instruction pointer (IP)
  - Data registers (AX, BX, CX, and DX)
  - Pointer registers (BP and SP)
  - Index registers (SI and DI)
  - *Segment registers* (CS, DS, SS, and ES).
  - Status register (SR) or (Flag register)

Software Model of the 8086 Microprocessor

- 8086 architecture implements independent memory and input/output address spaces.
- The memory address space is 1,048,576 bytes (1 M byte) in length and the I/O address space is 65,536 bytes (64 Kbytes) in length.

Memory Address Space and Data Organization

- The 8086 microprocessor **supports 1Mbytes** of memory.
- This memory space is organized from a software point of view as **individual bytes** of data stored at consecutive addresses over the address range 00000_{16} to $FFFFF_{16}$.
- The memory in an 8086-based microcomputer is actually organized as 8-bit bytes, not as 16 bit words.
- The 8086 can access **any two consecutive bytes as a *word* of data.**
- **The lower address byte** is the least significant byte of the word and the **higher address byte** is its most significant byte.

Memory Address Space and Data Organization

Example: From figure (a)

These two bytes represent the word $0101010100000010_2 = 5502_{16}$.

The high byte

low byte

The lower address byte (00724)
The higher address byte (00725)

LOW in LOW
HIGH in HIGH

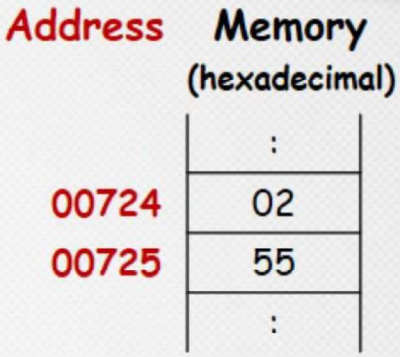
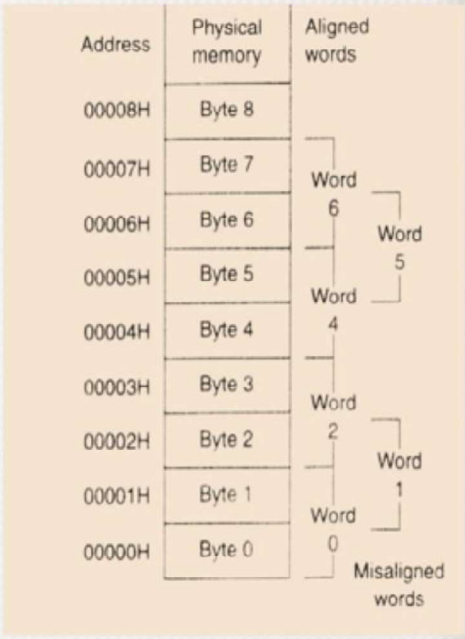


Figure (a)

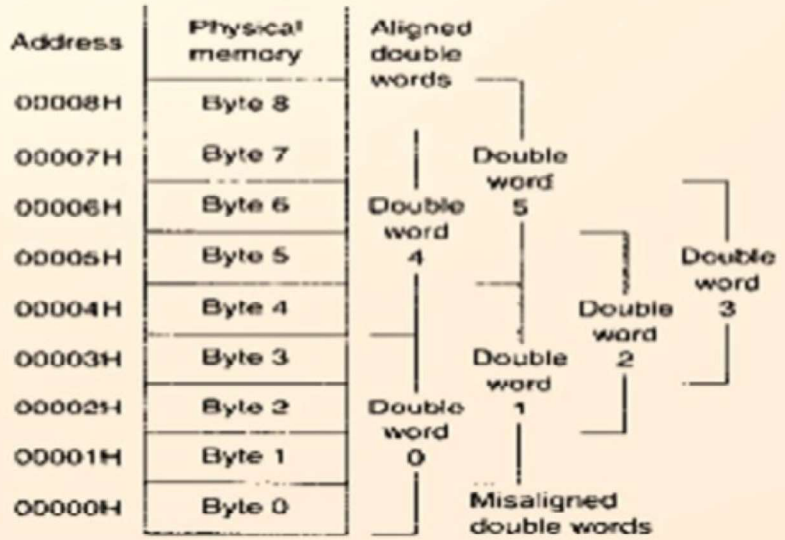
Memory Address Space and Data Organization

- To permit efficient use of memory, words of data can be stored at what are called even- or odd-addressed word boundaries.
- The least significant bit of the address determines the type of *word boundary*. If this bit is 0, the word is said to be held at an *even-address boundary*.
- A word of data stored at an even-address boundary, such as 00000_{16}, 00002_{16}, 00004_{16}, and so on, is said to be an aligned word. (all aligned words are located at an address that is a multiple of 2).
- A word of data stored at an odd-address boundary, such as 00001_{16}, 00003_{16}, or 00005_{16} and so on, is called misaligned word.



Memory Address Space and Data Organization

- A ***double word*** corresponds to four consecutive bytes of data stored in memory.



Memory Address Space and Data Organization

Example1:

Show how the word of data (02ED) store in memory location starting at address (EF05D)? Is the word aligned or misaligned?

02ED WORD , START ADDRESS = FE05D

MISALIGNED WORD.

	:
FE05D	ED
FE05E	02
	:

Example2:

Show how the double word of data (FF24EB55) store in memory location starting at address (A000E)? Is the double word aligned or misaligned?

	:
A000E	55
A000F	EB
A0010	24
A0011	FF
	:

WORD 2= FF24 WORD1=EB55

START ADDRESS A000E

Example3:

You have the following figure; What is the value of the word stored in memory starting at address (0210C)? Is the word aligned or misaligned?

0210B	:
0210C	22
0210D	0F
0210E	5A
0210F	00
02110	33
	:

WORD OF DATA = 0F22

0F	22
0210D	0210C

ALIGNED WORD

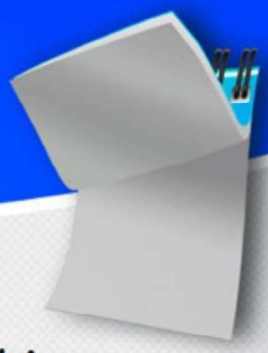
Example4:

You have the above figure; What is the value of the double word stored in memory starting at address (0210C)? Is the double word aligned or misaligned?

FIRST BUS CYCLE
WORD 1 (0F22)
SECOND BUS CYCLE
WORD2 (005A)

DOUBLEWORD= 005A0F22

8086 microprocessor internal registers



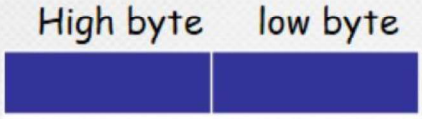
8086 consists of 13 register , All registers of size 16-bits

- Data registers (AX, BX, CX, and DX).
- *Segment registers* (CS, DS, SS, and ES).
- Instruction pointer (IP).
- Index registers (SI and DI).
- Pointer registers (BP and SP).
- Status register (SR) or (Flag register).

General Purpose Registers (data register)
(Ax , BX , CX , DX)

AX register (Accumulator)	BX register (base register)	CX register (count register)	DX register (data register)
used for all input/output operations some string operation and Arithmetic operations.	used as an index to extend addressing it's also used for computation	used for controlling the number of times a loop is repeated contains the value by which bits are shifted it's also used for computations.	Used for input/output operations. It use for multiply and divide operations

General Purpose Registers (data register)
(Ax , BX , CX , DX)

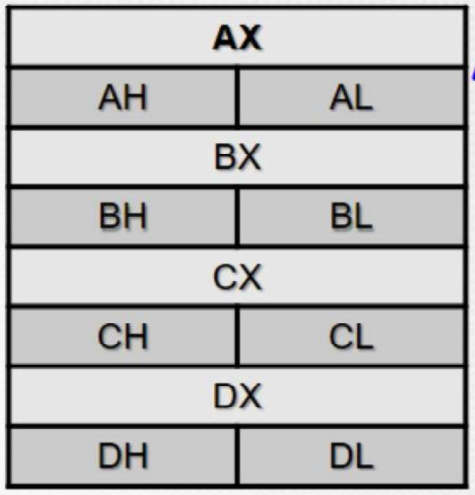


AX= 25F8
AL =F8
AH=25

BX =A5D

(0A5D)

BH= 0A
BL= 5D



A: Accumulator

B: Base reg.

C: Counter reg.

D: Data reg.

- Each register can be accessed as a byte or a word.
- The left most byte is a high-order 8 bits of register and the right most byte is the low-order 8bits.