Assignment 3

1. Consider a magnetic disk drive with 8 surfaces, 512 tracks per surface, and 64 sectors per track. Sector size is 1 KB. The average seek time is 8 ms, the track-to-track access time is 1.5 ms, and the drive rotates at 3600 rpm. Successive tracks in a cylinder can be read without head movement.

a. What is the disk capacity?

b. What is the average access time? Assume this file is stored in successive sectors and tracks of successive cylinders, starting at sector 0, track 0, of cylinder i.

c. Estimate the time required to transfer a 5-MB file.

Answer:

a.

8*512*64KB=256MB

b.

$$T_{total} = T_S + \frac{1}{2r} = 8ms + \frac{1}{2 * \frac{3600}{60}} * 10^3 ms = 16.3ms$$

c.

There are 5MB file in total, each track has 64*1KB=64KB

Which is

$$\frac{5MB}{64KB} = 80 \text{ tracks}$$

$$\mathrm{n} = \frac{80}{8} = 10 cylinders$$

Time required in changing track is

$$T_{\mathrm{change}} = (10-1) * 1.5ms = 13.5ms$$

Time to seek the first cylinder is

$$T_{seekfirst} = T_{average} = 8ms$$

Therefore

$$\begin{aligned} T_{total} &= T_{seekfirst} + \frac{1}{2r} * n + \frac{b}{rN} + T_{\mathrm{change}} \\ &= 8ms + \frac{1}{2 * \frac{3600}{60}} * 10^3 ms * 10 + \frac{5MB}{\frac{3600}{60} * 64KB} * 10^3 ms + 13.5ms \\ &= 1425.5ms \end{aligned}$$

2. A system is based on an 8-bit microprocessor and has two I/O devices. The I/O controllers for this system use separate control and status registers. Both devices handle data on a 1-byte-at-a-time basis. The first device has two status lines and three control lines. The second device has three status lines and four control lines.
a. How many 8-bit I/O control module registers do we need for status reading and control of each device?
b. What is the total number of needed control module registers given that the first device is an output-only device?
c. How many distinct addresses are needed to control the two devices?

Answer:

a. For each device, it needs one register to read status and one to control, so 2+2=4 registers in total.
b. For each device, it needs:
    one register for status
    one register for control
    one register for output
   and for the second device, it also needs a input line, so 2*3+1=7 register in total.
c. For the first device, it needs three lines, for the second, it needs four lines, so 3+4=7 addresses.

3. Assume numbers are represented in 8-bit twos complement representation. Show the calculation of the following:
a. 6 + 13   b. -6 + 13   c. 6 - 13   d. -6 – 13

Answer：
a. 6 + 13 = 19

$$\begin{array}{r} 00000110 \\ \underline{00001101} \\ 00010011 \end{array}$$

Check: 00010011b= 16+2+1=19

b. -6 + 13 = 7

$$\begin{array}{r} 11111010 \\ \underline{00001101} \\ 00000111 \end{array}$$

Check: 00000111b =4+2+1=7

c. 6 – 13=-7

$$\begin{array}{r} 00000110 \\ \underline{11110011} \\ 11111001 \end{array}$$

Check: 11111001b=-(00000111b)=-(4+2+1)=-7

d. -6 – 13

$$\begin{array}{r} 11111010 \\ \underline{11110011} \\ 11101101 \end{array}$$

Check: 11101101b=-(00010011b)=-(16+2+1)=-19

4. Compare zero-, one-, two-, and three-address machines by writing programs to compute

$$X = (A + B \times C)/(D - E \times F)$$

for each of the four machines. The instructions available for use are as follows:

0 Address	1 Address	2 Address	3 Address
PUSH M	LOAD M	MOVE $(X \leftarrow Y)$	MOVE $(X \leftarrow Y)$
POP M	STORE M	ADD $(X \leftarrow X + Y)$	ADD $(X \leftarrow Y + Z)$
ADD	ADD M	SUB $(X \leftarrow X - Y)$	SUB $(X \leftarrow Y - Z)$
SUB	SUB M	MUL $(X \leftarrow X \times Y)$	MUL $(X \leftarrow Y \times Z)$
MUL	MUL M	DIV $(X \leftarrow X/Y)$	DIV $(X \leftarrow Y/Z)$
DIV	DIV M		

Answer:

PUSH B	LOAD E	MOVE (R1←E)	MUL (R1←BxC)
PUSH C	MUL F	MUL (R1←R1xF)	ADD (R1←A+R1)
MUL	STORE R1	MOVE (R2←D)	MUL (R2←ExF)
PUSH A	LOAD D	SUB (R2←R2-R1)	SUB (R2←D-ExF)
ADD	SUB R1	MOVE (R1←B)	DIV (X←R1/R2)
PUSH D	STORE R1	MUL (R1←R1xC)	
PUSH E	LOAD C	ADD (R1←R1+A)	
PUSH F	MUL B	DIV (R1←R1/R2)	
MUL	ADD A	MOVE (X←R2)	
SUB	STORE R2		
DIV	DIV R1		
POP X			