Ex_08_Multi

mercoledì 4 marzo 2020 16:19

A HDD has a rotation speed of 10000 RPM,
an average seek time of 4 ms,
a negligible controller overhead and transfer rate of 256 MB/s.
Files are stored into blocks whose size is 4 KB.

Compute:

a. The rotational latency of the disk
b. The time required to read a 400 KB file divided into 5 sets of contiguous blocks
c. The time required to read a 400 KB file with a locality of 95%

(A) $T_{ROT} = \frac{1}{2} * \frac{60 * 1000}{10000} = 3\,ms$

(B) $\#BLOCKS = \frac{400\,KB}{4\,KB} = 100$

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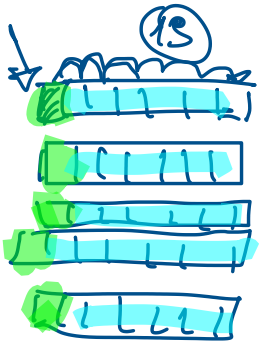


$T_{READ}^{400KB} = 5 * T_{READ\ NO\ LOCK}^{4KB} + 95\ T_{READ\ LOCAL}^{4KB}$

$T_{READ\ NO\ LOCK}^{4KB} = T_{OH} + T_T + T_{RL} + T_{SEEK} =$

$= \cancel{\phi} + \frac{4\,KB}{256\,MB/s} + 3\,ms + 4\,ms$

$T_{READ\ LOCAL}^{4KB} = T_{OH} + T_T = \cancel{\phi} + \frac{4\,KB}{256\,\frac{MB}{s}}$

$T_{READ}^{400KB} = 100\,T_T + 5\,(T_{RL} + T_{SEEK})$

$= \frac{400\,KB}{256\,\frac{MB}{s}} + 5 * 7\,ms =$

$= \frac{400\,KB}{256 * 1024\,\frac{KB}{s}} + 35\,ms$

$= 1.5\,ms + 35\,ms = 36.5\,ms$

(C) THE SAME AS B

Ex_10_Min_Max

mercoledì 4 marzo 2020 16:21

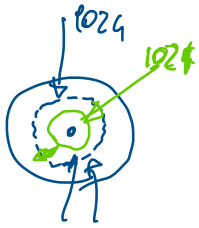
Disk controllers map logical blocks to physical locations on the disk. Suppose that a 1MB file consisting of 512-byte logical blocks is stored on a disk drive with the following characteristics:

- Rotational rate: 10,000 RPM → $3ms = T_R$
- Average seek time 5ms
- Average # sectors/track 1024
- Sector size 512 bytes

Suppose that a program reads all the blocks of this file sequentially, and that the time to position the head over the first block is the average seek time plus the average rotational latency.

- What is the best case for mapping logical blocks to disk sectors? Estimate the time required to read the file in this best case scenario.
- Suppose that the logical blocks are mapped randomly to disk sectors. Estimate the time required to read the file in this scenario.

1) $\#BLOCKS = \frac{1MB}{512By} = \frac{1024\,KB}{0.5\,KB} = 2048$



$\frac{60\,sec \cdot 1000}{10000\,R/min} = 6ms$

$T^{IDEAL}_{1MB} = T_{SEEK} + T_{RL} + T^{i}_{TT}$

$= 5ms + 3ms + 2048\,\frac{6ms}{1024} =$

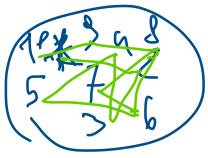
$= 8ms + 2 * 6ms = 20ms$

20 ms "IDEAL"

$T^{"AVG\ IDEAL"}_{1MB} = 2 * (T_{SEEK} + T_{RL} + T^{i}_{TT}\,\frac{1}{2}KB)$

$= 2 * (8ms + 6ms) = 28ms$

2)



$T^{WC}_{1MB} = 2048\,(T_{SEEK} + T_{RL} + T^{i}_{TT}\,\frac{1}{2}KB)$

$= 2048 * (8ms + \ldots) \cong 16sec$

"WC"

16 sec

EX_11_Comparison_HighSpeed_HighCapacity

venerdì 13 marzo 2020 14:36

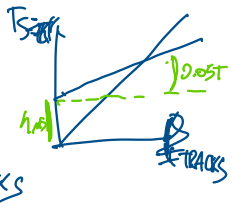
	C Cheetah 15K.5	B Barracuda
Capacity	300 GB	1 TB
RPM	15,000	7,200
Average Seek	4 ms	9 ms
Max Transfer	125 MB/s	105 MB/s
Platters	4	4
Cache	16 MB	16/32 MB
Connects via	SCSI	SATA

Considering a block of 4KB, compare the two disks in terms of accesses to all random and all sequential blocks

	C	B
T_{SEEK}	4 ms	9 ms
T_{RL}	$\frac{1}{2} * \frac{1}{15000} * 60 = 2$ ms	$\frac{1}{2} * \frac{1}{7200} * 60 = 4.17$ ms
T_{TT}	$\frac{4KB}{125 * 1024 \frac{KB}{s}} = 0.031$ ms	$\frac{4KB}{105 * 1024 \frac{KB}{s}} = 0.037$ ms
$T_{4KB\ RANDOM}$	$= T_{RL} + T_{SEEK} + T_{TT}$ $= 6.031$ ms	$= T_{RL} + T_{SEEK} + T_{TT}$ $= 13.207$ ms
BW_{RAND}	$\frac{4KB}{6.031 ms} = 663 \frac{KB}{s}$	$\frac{4KB}{13.207 ms} = 310 \frac{KB}{s}$
$T_{4K\ SEQ}$	$= T_{TT}^{4K}$ $= 0.031$ ms	$= T_{TT}^{4K}$ $= 0.037$ ms
BW_{SEQ}	125 MB/s	105 MB/s

Ex_12_Seek_Model

mercoledì 4 marzo 2020 17:01



An hard disk rotates at 5400 rpm with an arm seek time given by = 4 + 0.05t msec, where t is the number of tracks the arm seeks. Assume a block size of 512 bytes, and 1024 tracks with 512 sector/track. The disk controller and DMA read or write data from/to disk at a rate of 4MB/sec.

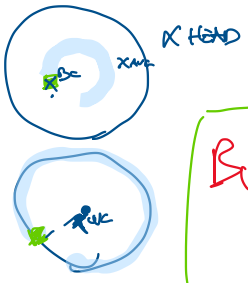
- What is the storage capacity of the disk?
- Assume that we are reading a 16K-bytes file where the sectors happen to be allocated contiguously on the same track. Compute the maximum, "average" and minimum disk throughput that is possible while reading the file?

1) $\text{DISK CAPACITY} = \frac{1}{2}\frac{KB}{\text{SECTOR}} * 512\frac{\text{SECTORS}}{\text{TRACK}} * 1024\ \text{TRACKS} = 256\ MB$

2) $T_{BC}^{16KB} = T_R + T_{SEEK} + T_T^{16KB}$

$= 0 + 0 + \frac{16\ KB}{4 * 1024\ \frac{KB}{S}}$

$= 3.9\ ms$



$T_{AC}^{16KB} = T_R + T_{SEEK} + T_T^{16KB}$

$\frac{1}{2} * \frac{60}{5400} * 1000 = 5.55\ ms$

$+ 3.9\ ms$

$\frac{1024}{3} = t$

$T_{SEEK} = 4 + 0.05t \approx 21.06\ ms$

$= 5.55 + 21.06 + 3.9 = 30.51\ ms$

$Bw = \frac{16\ KB}{3.9\ ms} = 4\ MB/S$

$Bw = \frac{16\ KB}{30.51\ ms} = 524\ KB/S$

$T_{WC}^{16KB} = T_R + T_{SEEK} + T_T^{16KB}$

$11.1 \qquad +3.9\ ms$

$t = 1024$

$T_{SEEK} = 4 + 0.05 * 1024$

$= 11.1 + 55.2 + 3.9 = 70.2\ ms$

$Bw = \frac{16\ KB}{70.2\ ms} = 228\ KB/S$

Further Reading

lunedì 16 marzo 2020 11:37

http://pages.cs.wisc.edu/~remzi/Classes/838/Fall2001/Papers/diskmodel-computer94.pdf

An introduction to disk drive modeling

Chris Ruemmler and John Wilkes
Hewlett-Packard Laboratories, Palo Alto, CA

Much research in I/O systems is based on disk drive simulation models, but how good are they? An accurate simulation model should emphasize the performance-critical areas.

This paper has been published in IEEE Computer **27**(3):17–29, March 1994. It supersedes HP Labs technical reports HPL–93–68 rev 1 and HPL–OSR–93–29.