CS471: Operating System Concepts
Fall 2006
(Lecture: TR 11:25-12:40 PM)
Homework #6
Points: 20
Due: October 12, 2006

Question 1 [Points 10] Exercise 12.2 with the following order of pending requests: 20, 3000, 550, 4900, 3700, 3200, 200, 4700, 3200, 250

Solution1: Current cylinder is 143 and previous were 125.

FCFS:

143	--	20	=	123
20	--	3000	=	2980
3000	--	550	=	2450
550	--	4900	=	4350
4900	--	3700	=	1200
3700	--	3200	=	500
3200	--	200	=	3000
200	--	4700	=	4500
4700	--	3200	=	1500
3200	--	250	=	2950

Total = 23553

SSTF:

143	--	200	=	57
200	--	250	=	50
250	--	20	=	230
20	--	550	=	530
550	--	3000	=	2450
3000	--	3200	=	200
3200	--	3200	=	0
3200	--	3700	=	500
3700	--	4700	=	1000
4700	--	4900	=	200

Total = 5217

SCAN:

143	--	200	=	57
200	--	250	=	50
250	--	550	=	300
550	--	3000	=	2450
3000	--	3200	=	200
3200	--	3200	=	0
3200	--	3700	=	500
3700	--	4700	=	1000
4700	--	4900	=	200
4900	--	4999	=	99
4999	--	20	=	4979

Total = 9835

C-SCAN:

143	--	200	=	57
200	--	250	=	50
250	--	550	=	300
550	--	3000	=	2450
3000	--	3200	=	200
3200	--	3200	=	0
3200	--	3700	=	500
3700	--	4700	=	1000
4700	--	4900	=	200
4900	--	4999	=	99
4999	--	0	=	4999
0	--	20	=	20

Total = 9875

LOOK:

143	--	200	=	57
200	--	250	=	50
250	--	550	=	300
550	--	3000	=	2450
3000	--	3200	=	200
3200	--	3200	=	0
3200	--	3700	=	500
3700	--	4700	=	1000
4700	--	4900	=	200
4900	--	20	=	4880

Total = 9637

C-LOOK:

143	--	200	=	57
200	--	250	=	50
250	--	550	=	300
550	--	3000	=	2450
3000	--	3200	=	200
3200	--	3200	=	0
3200	--	3700	=	500
3700	--	4700	=	1000
4700	--	4900	=	200
4900	--	20	=	4880
		Total	=	9637

Question 2 [Points 4] Consider a RAID Level 5 (http://www.pcguide.com/ref/hdd/perf/raid/levels/singleLevel5-c.html) organization comprising of 5 disks. File data is circularly distributed among these five disks, each strip consisting of one block. A single parity is computed for 4 (logically contiguous) blocks, and it is written on the 5th block. For example, if the 4 blocks are located on disks 2,3,4,5, then the parity for the 4 blocks together is written on disk 1.
How many blocks are accessed in order to perform the following?
A. A read of one block of data.
B. A write of one block of data
C. A write of seven continuous (of a file) block of data
(Hint: Parity is used to verify if the data has been corrupted or not before returning to the user.)

Solution:

A) To read one block of data we need to access 5 blocks; since parity is computed for 4 blocks together, even to read one block of data, we need to **read 4 blocks of data**; followed by one block of parity. (For example, to read block 2, we need to read blocks 1-4, and also parity block which computes a single parity on 1-4 blocks.)

B) To write one block, we need to read additional 3 blocks, compute the parity, and write the intended data block and the computed parity block. In summary: 3 reads; 2 writes.

C) Let us say we are writing blocks x, x+1, x+2, x+3, …,x+6
Parity is computed for blocks 1-4, and write parity block.
Case i: if x is 1,5,9, etc….: Then, we need
Write x, x+1, x+2, x+3; write a parity block---5 writes
Write x+4, x+5, x+6; read x+7 (if exists); write parity---4 writes, 1 read
Total: 9 writes + 1 read; → 10 accesses
Case ii: x is 2,6,10,14, …; Then, we need:
Read x-1; Write x, x+1, x+2; write a parity block---4 writes; 1 read
Write x+3, x+4, x+5; x+6; write parity---5 writes
Total: 9 writes and 1 read → 10 accesses;

Case iii: x is 3,7,11,15, …; Then, we need:

Read x-2, x-2; Write x, x+1; write a parity block---3 writes; 2 read
Write x+2, x+3, x+4; x+5; write parity---5 writes
Write x+6; read x+7, x+8, x+9 (if they exist); write parity---2 writes, 3 reads
Total: 10 writes and 5 reads → 15 accesses;

Case iv: x is 4,8,12,…Then we need

Read x-3, x-2. x-1; Write x; write a parity block---2 writes; 3 read
Write x+1, x+2, x+3, x+4; write parity---5 writes
Write x+5, x+6; read x+7, x+8 (if they exist); write parity---3 writes, 2 reads
Total: 10 writes and 5 reads → 15 accesses;

Question 3 [Points 2] Exercise 12.21

Solution:

Optical disk:

Radius of the optical disk = 5.25/2 = 2.625 inches
Area of the optical disk = 3.14*2.625*2.625 = 21.656 square inches.

Let the diameter of the of the spindle hub be 1.5 inches.
Therefore, radius = 1.5/2 = .75 inches.
Area of the hub = 3.14 * .75 * .75 = 1.766 square inches

Total area on optical disk for data storage = 21.656 – 1.766 = 19.89 sq inches.

The storage capacity of the optical disk = 19.89 * 1 gigabit/sq inch
= 19.89/8 gigabytes
= 2.48 gigabytes

Tape:

Length of the tape = 1800 feet = 1800 * 12 = 21,600 inches
Width of the tape = .5 inches

Area of the tape = 3600 * .5 = 10,800 sq inches

Storage capacity of the tape = 10,800 * 20 megabits/sq inch
= 10,800 * 20 * 10, 00,000 bits
= 27 gigabytes

Storage density of the tape = 10,800 * 1,00,00,00,000 /8 gigabytes
= 1350 gigabytes

Therefore, if we charge the same price per GB for the optical tape as for magnetic tape, the optical tape cartridge would cost about 50 times more than the magnetic tape.

Cost = 1350 * $ 25 / 27 = $ 1,250

Question 4 [Points 2] 10.1

Solution: Let F1 be the old file and F2 be the new file. A user wishing to access F1 through an existing link will actually access F2.

This problem can be avoided by insuring that all links to a deleted file are deleted also.

This can be accomplished in several ways.

a) Maintain a list of all links to a file, removing each of then when the file is deleted.
b) Retain the links, removing them when an attempt is made to access a deleted file.
c) Maintain a file reference list (or counter), deleting the file only after all links or references to that have been deleted.

Question 5 [Points 2] 10.9

Solution: With a single copy, several concurrent updates to a file may result in a user obtaining incorrect information, and the file being left in an incorrect state. With multiple copies, there is a storage waste and the various copies may not be consistent with respect to each other.