Homework 7

Due on November 30 (Tuesday), 2021

Problem 1.

A hard disk has an average seek time of 8 ms, a rotational speed of 7200 rpm, and average 63 sectors per track.

Question 1
Compute the average time to read a sector.

Question 2
Compute the average time to read 10 sectors if they are contiguous on the same track.

Question 3
What is the average time if the 10 sectors are located randomly on the disk?

Problem 2.

Consider a virtual memory system that can address a total of 2^{32} Bytes. The disk space is unlimited, but the DRAM memory space is only 8 MB. The virtual and physical page sizes are 4 KB.

Question 1
How many bits are used to index the physical memory address?

Question 2
What is the maximum number of virtual pages in the system?

Question 3
How many physical pages are in the system?

Question 4
How many bits are used for virtual pages, and for physical pages?

Question 5
If we use a direct mapped scheme to map virtual pages to physical pages, which is similar to direct mapped cache, how many least significant bits of the virtual page index do you use to determine the direct map? How many virtual pages are mapped to each physical pages? What impact does this scheme make to the virtual memory system?

Problem 3.

Considering a disk with a number of tracks and each track has multiple sectors, we have a notation of a disk visit as (a, b), where a is the disk track number and b is the sector number on track a. For the following sequence of requests:

(1, 23), (2, 57), (1,1), (1, 89), (2, 13), (2,78), (1,5), (2,75), (3, 45), (3,98), (2,72), (3,47), (2,76), (3,97).

If you know this set of requests in advance, how would you reorder the sequence to minimize the total disk access time?

Problem 4.

The average time to read a sector is

T_sec = T_seek + T_rotate + T_transfer

Question 1
Drive a formula of average access time for *n+m* accesses, where *n* is the number of sequential disk accesses on the same track and *m* is the number of random disk accesses on different tracks.

Question 2
A hard disk has an average seek time of 8 ms, a rotational speed of 7200 rpm, and average 63 sectors per track. How many sequential sector accesses are equivalent to two random sector accesses on this disk?