Homework Assignment #4

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- Chap.10: 10.21, 10.24, 10.37
- Chap.11: 11.13, 11.20, 11.21
- Chap.14: 14.14, 14.15
- Programming problems:
  - Chap.10: 10.44*
  - Chap.11: 11.27*
- Note: Each student must complete all programming problems on your own
- Due: two weeks (Jun. 13, 2024)

- Chap. 10:
  - 10.21: Assume that we have a demand-paged memory.
    - The page table is held in registers.
    - It takes 8 milliseconds to service a page fault if an empty frame is available or if the replaced page is not modified and 20 milliseconds if the replaced page is modified.
    - Memory-access time is 100 nanoseconds.
  - Assume that the page to be replaced is modified 70 percent of the time.
  - What is the maximum acceptable page-fault rate for an effective access time of no more than 200 nanoseconds?

- 10.24: Apply the (1) FIFO (2) LRU (3) Optimal (OPT) replacement algorithms for the following page reference string:
  3, 1, 4, 2, 5, 4, 1, 3, 5, 2, 0, 1, 1, 0, 2, 3, 4, 5, 0, 1.
  Indicate the number of page faults for each algorithm assuming demand paging with three frames.

- 10.37: What is the cause of thrashing? How does the system detect thrashing? Once it detects thrashing, what can the system do to eliminate this problem?

- Chap.11
  - 11.13: Suppose that a disk drive has 5,000 cylinders, numbered 0 to 4,999.
  - The drive is currently serving a request at cylinder 2,150, and the previous request was at cylinder 1,805.
  - The queue of pending requests, in FIFO order, is 2,069; 1,212; 2,296; 2,800; 544; 1,618; 356; 1,523; 4,965; 3,681

- Starting from the current head position, what is the total distance (in cylinders) that the disk arm moves to satisfy all the pending requests, for each of the following disk-scheduling algorithms?
  (a) FCFS
  (b) SCAN
  (c) C-SCAN

- 11.20: Consider a RAID level 5 organization comprising five disks, with the parity for sets of four blocks on four disks stored on the fifth disk.
  - How many blocks are accessed in order to perform the following?
    (a) A write of one block of data.
    (b) A write of seven contiguous blocks of data.

- 11.21: Compare the throughput achieved by a RAID level 5 organization with that achieved by a RAID level 1 organization.
  - (a) Read operations on single blocks.
  - (b) Read operations on multiple contiguous blocks.

- Chap.14
  - 14.14: Consider a file system on a disk that has both logical and physical block sizes of 512 bytes.
  - Assume that the information about each file is already in memory
  - For each of the three allocation strategies (contiguous, linked, and indexed), answer these questions:
  - (a) How is the logical-to-physical address mapping accomplished in this system? (For indexed allocation, assume that a file is always less than 512 blocks long)
  - (b) If we are currently at logical block 10 (the last block accessed was block 10) and want to access logical block 4, how many physical blocks must be read from the disk?

- 14.15: Consider a file system that uses inodes to represent files
- Disk blocks are 8KB in size, and a pointer to a disk block requires 4 bytes
- This file system has 12 direct disk blocks, as well as single, double, and triple indirect disk blocks
- What is the maximum size of a file that can be stored in this file system?

Programming Problem for Chap.10

- 10.44*: Write a program that implements the FIFO, LRU, and optimal (OPT) page-replacement algorithms presented in Sec.10.4.
  - Have your program initially generate a random page-reference string where page numbers range from 0 to 9.
  - Apply the random page-reference string to each algorithm, and record the number of page faults incurred by each algorithm.
  - Pass the number of page frames to the program at startup.
  - You may implement this program in any programming language of your choice.

Programming Problem for Chap.11

- 11.27*: Write a program that implements the following disk-scheduling algorithms:
  (a) FCFS
  (b) SCAN
  (c) C-SCAN
- Your program will service a disk with 5,000 cylinders numbered 0 to 4,999.
- The program will generate a random series of 1,000 cylinder requests and service them according to each of the algorithms listed above.
- The program will be passed the initial position of the disk head (as a parameter on the command line) and report the total amount of head movement required by each algorithm.

Any Questions or Comments?