CSC415 OPERATING SYSTEM PRINCIPLES

Homework 2 Solution

1. (15 Points) Consider the following segment table:

Segment	Base	Length
0	219	600
1	2300	14
2	90	100
3	1327	580
4	1952	96

What are the physical addresses for the following logical addresses?
   a. 0,430
   b. 1,10
   c. 2,500
   d. 3,400
   e. 4,112

Sol:
   a. 219 + 430 = 649
   b. 2300 + 10 = 2310
   c. illegal reference, trap to operating system
   d. 1327 + 400 = 1727
   e. illegal reference, trap to operating system

2. (10 Points) What is internal fragmentation? Give an example of when it occurs.

   Sol:
   Internal fragmentation happens when the memory allocated to a process is larger than the required memory and the leftover space is unavailable for use by the system. Example: fixed-sized partition, paging

3. (10 Points) Assuming a byte-addressed system with 24-bit logical and physical addresses and 2 MB pages, translate the following logical addresses into physical addresses using the provided page table:

Page	Frame
0	1

```
1    4
2    7
3    3
4    2
5    5
6    6
7    0
```

    a. 0x234800
    b. 0xBB4400

Sol:

    c. 0x834800
    d. 0xBB4400

4. (18 Points) Consider the following page reference string: 1, 3, 2, 4, 3, 5, 6, 7, 2, 3, 2, 1, 7, 6, 5, 4, 7, 2, 5, 6. How many page faults would occur for the page replacement algorithms FIFO, Optimal, and LRU, assuming one, four, and seven free frames at the beginning?

Sol:
FIFO
1 frame: 20   4 frames: 16   7 frames: 7
Optimal
1 frame: 20   4 frames: 11   7 frames: 7
LRU
1 frame: 20   4 frames: 15   7 frames: 7

5. (14 Points) What is the cause of thrashing? Once thrashing is detected, what can the system do to eliminate this problem?

Sol:
Thrashing is caused by under-allocation of the minimum number of pages required by a process, forcing it to continuously page fault. It can be eliminated by reducing the level of multiprogramming (i.e., reduce the number of processes in main memory).

6. (18 Points) Suppose that a disk drive has 5,000 cylinders, numbered 0 to 4999, with the read-write head having just finished a request at cylinder 1056. The queue of pending

requests, in order of arrival, is:

333, 1200, 922, 4545, 3786, 3605

Starting from the current head position, what is the order in which the requests will be serviced for each of the following disk-scheduling algorithms (assuming no other requests arrive and the head's initial movement is toward higher numbered cylinders for c-f)?

a. FCFS   b. SSTF   c. SCAN   d. LOOK   e. C-SCAN   f. C-LOOK

Sol:
   a. FCFS
      333, 1200, 922, 4545, 3786, 3605
   b. SSTF
      922, 1200, 333, 3605, 3786, 4545
   c. SCAN
      1200, 3605, 3786, 4545, 922, 333
   d. LOOK
      1200, 3605, 3786, 4545, 922, 333
   e. C-SCAN
      1200, 3605, 3786, 4545, 333, 922
   f. C-LOOK
      1200, 3605, 3786, 4545, 333, 922

7. (15 Points) Describe the procedure for handling the page fault when there is always a free frame in demand paging.

   Sol:
   OS determines whether the reference is a valid or an invalid memory access. If it is invalid access, the process is terminated. If it is valid but the page is not in memory, OS finds a free frame and read the page into the frame. Then, it updates the page table to indicate that the page is in memory, and restarts the instruction that caused the page fault.