Review Questions – Virtual Memory (Chapter 10)

Operating Systems SFWRENG 3SH3 Term 2, Winter 2023

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Questions

1. Consider the page table shown below for a system with 12-bit virtual and physical addresses and with 256-byte pages. The list of free page frames is D, E, F (that is, D is at the head of the list, E is second, and F is last). Convert the following virtual addresses to their equivalent physical addresses in hexadecimal. All numbers are given in hexadecimal. (A dash for a page frame indicates that the page is not in memory.)

Page	Page Frame
0	–
1	2
2	C
3	A
4	–
5	4
6	3
7	–
8	B
9	0

   a. 9EF
   b. 111
   c. 700
   d. 0FF

   What is demand paging and pure demand paging?

2. Consider the following page reference string:
   7, 2, 3, 1, 2, 5, 3, 4, 6, 7, 7, 1, 0, 5, 4, 6, 2, 3, 0, 1.

   Assuming demand paging with three frames, how many page faults would occur for the FIFO replacement algorithm?

3. Consider the following page reference string:
   7, 2, 3, 1, 2, 5, 3, 4, 6, 7, 7, 1, 0, 5, 4, 6, 2, 3, 0, 1.
   Assuming demand paging with three frames, how many page faults.

would occur for the following replacement algorithms?

a. LRU replacement
b. FIFO replacement
c. Optimal replacement

4. Consider the following page reference string:
7, 2, 3, 1, 2, 5, 3, 4, 6, 7, 7, 1, 0, 5, 4, 6, 2, 3, 0, 1.

   Assuming demand paging with three frames, how many page faults would occur for the following replacement algorithms?

   a. LRU replacement
   c. Optimal replacement

5. The VAX/VMS system uses a FIFO replacement algorithm for resident pages and a free-frame pool of recently used pages. Assume that the free-frame pool is managed using the least recently used replacement policy. Answer the following questions:

a) If a page fault occurs and if the page does not exist in the free-frame pool, how is free space generated for the newly requested page?
b) If a page fault occurs and if the page exists in the free-frame pool how is the resident page set and the free-frame pool managed to make space for the requested page?
c) What does the system degenerate to if the number of resident pages is set to one?
d) What does the system degenerate to if the number of pages in the free-frame pool is zero?

6. 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?

7. Assume there is an initial 16 KB segment where memory is allocated using the Buddy system. As shown in lecture notes on the Buddy system, draw the tree illustrating how the following memory requests are allocated:
   a. request 3.6 KB
   b. request 1.5 KB
   c. request 1.2 KB
   d. request 1.9 KB
   e. request 2.7 KB

   Next, modify the tree for the following releases of memory. Perform coalescing whenever possible and list the available segment sizes:

   1. release 1.2 KB
   2. release 1.9 KB

3. release 1.5 KB